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Saving Men from Sunken Submarines

Three means by which the crew of a sunken submarine may finally escape

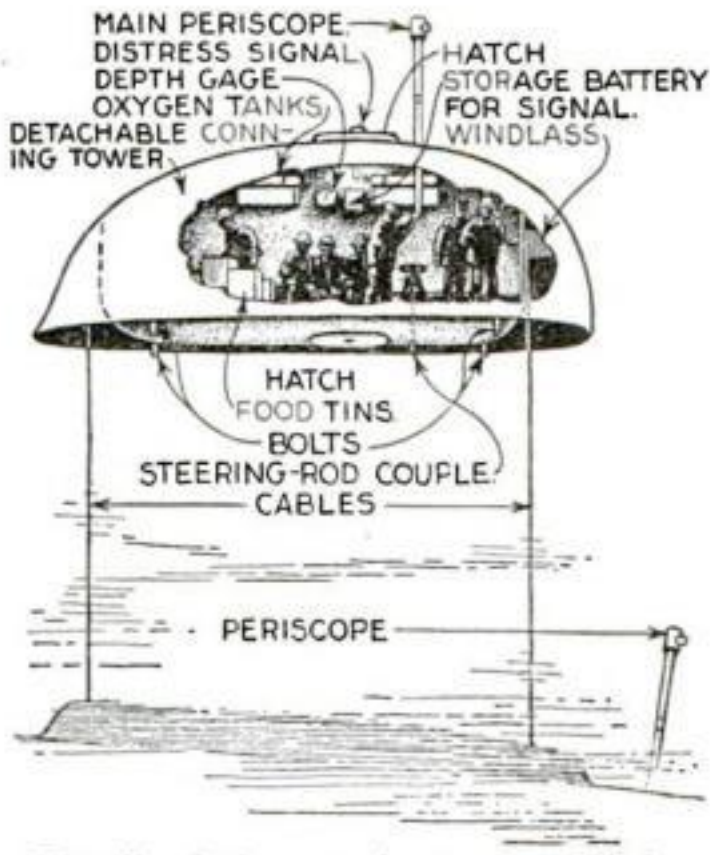
By Lloyd M. Kuh

"TWELVE-THIRTY o'clock. Respiration is extraordinarily difficult. I mean I am breathing gasoline.

"It is 12:40 o'clock."

Such were the last words of the commander of the Japanese "6", written while imprisoned in the conning-tower of his submarine at the bottom of the sea. This was some six years ago, when he and thirteen of his crew met with an accident and died a slow and painful death, simply because the submarine was not provided with a suitable means of escape.

Even before this time, one hundred and twenty-four men had been lost on that account; and as many have been lost since then—all in times of peace. But the fault was nobody's; for no rescuing devices had been invented which could have been depended upon and which at the same time did not take up too much of the all-too-precious space.



Detail of the conning-tower which is released from the submarine

And we are still experimenting on devices for saving men from sunken submarines. A great many schemes have been invented, a few of which at least indicate that we are on the right track. These few divide themselves into three classes.

In the first class are those devices which have a buoyant detachable conning-tower. This tower contains all the appliances of an ordinary conning-tower; but such things as the steering-rod must be made in two parts which can be separated when the tower is disconnected from the body of the submarine. A windlass is mounted at each end of the tower and upon each a cable is wound. The other ends of the cables are fastened to the body of the submarine. Four large bolts hold the tower to the submarine's body.

Should anything go wrong, all the men can climb into the tower, close the hatch behind them, turn on the oxygen from the tanks, unscrew the bolts and rise to the surface. By means of the handles of the windlasses, the speed of the tower can be controlled as it rises. When they reach the surface, they can open the windows and send out signals of distress by an electric flashlight.

This plan will work should the submarine sink as far as three hundred feet. Below this depth no scheme will be of use, for the water pressure is so enormous that it will actually force the water right through the pores of the steel hull. This "sweating"—as an engineer would call it—would soon weaken the rivets and finally result in crushing the submarine like an egg-shell!

An entirely different invention has two compartments within the submarine, from which the crew can escape through hatches to the top of the boat. To open the hatches, it is necessary to let water into the compartments through a valve, until the

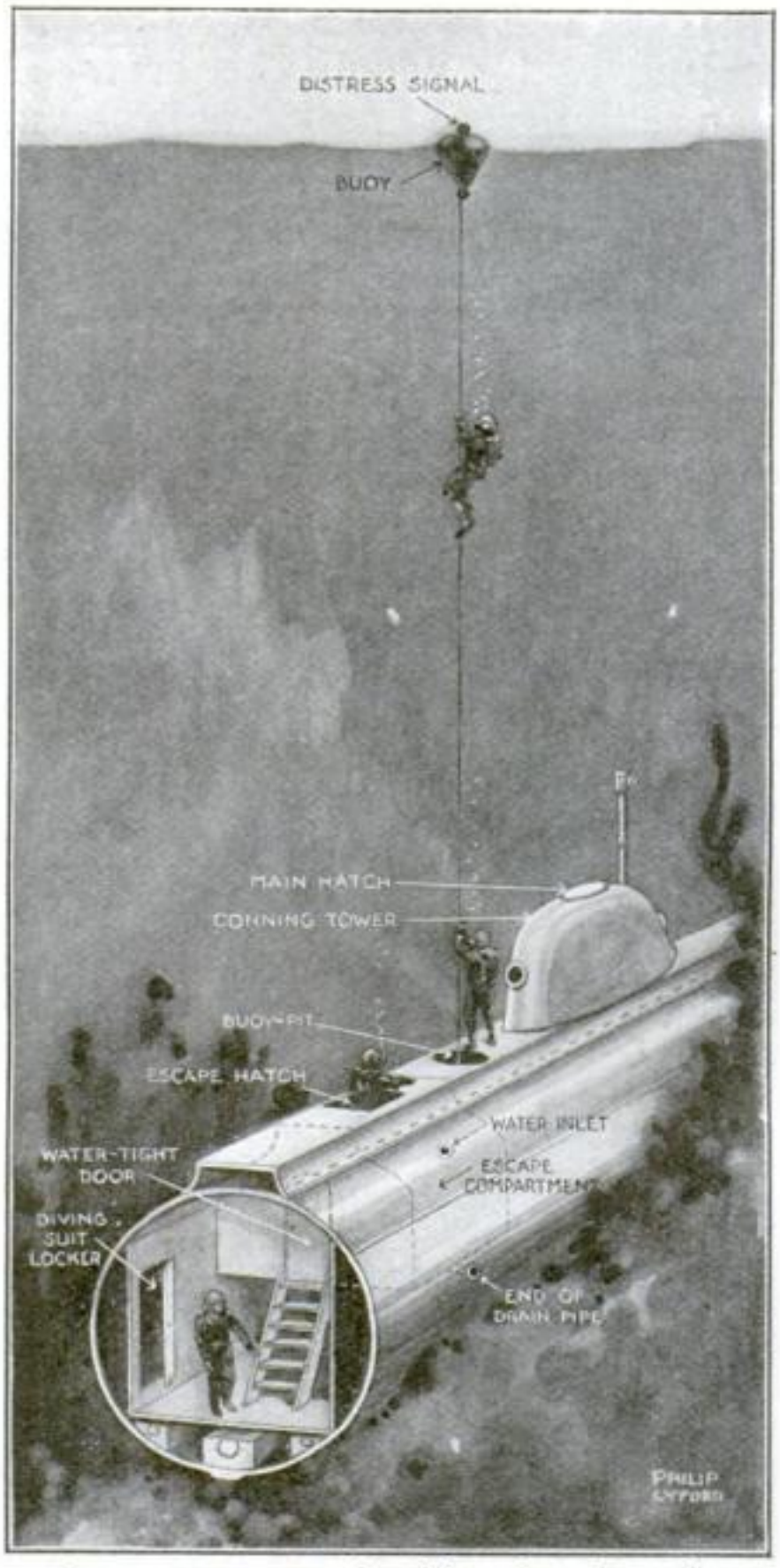
compartments are completely filled. In this way the great pressure of the water on top of the hatches is relieved.

In an emergency, the crew immediately put on light diving-suits. These contain oxygen apparatus which not only prevent suffocation, but also prevent the water from crushing the body. Three or four men enter each compartment and shut the water-tight door behind them. Letting in the water, they open the hatch and climb out. After they have emerged, the hatch is closed by gears connected to it in the inside of the submarine. The water in the compartment is then ejected into the ocean through drain-pipes connected with a hydraulic hand-pump which the imprisoned men operate. Then three or four more of them may enter the compartment and escape in the same way.

After all the crew reach the top of the boat they release a buoy which moves upward towards the surface cable with it. Up this the men must climb.

It seems strange that they must *climb* out and are not forced upwards as soon as they touch the water. The reason for this is that the weight of the suits is so great that, peculiarly enough, it tends to keep the men at whatever level they happen to be.

Due to the fact that the men have to expose themselves to the pressure of the water, this plan cannot be used at a greater depth than 225 feet. Even at this depth, the pressure is 8¼ tons per square foot. Divers have gone down this far; but one, who went down 288 feet, at the time of the F-4 disaster, permanently injured his lungs.



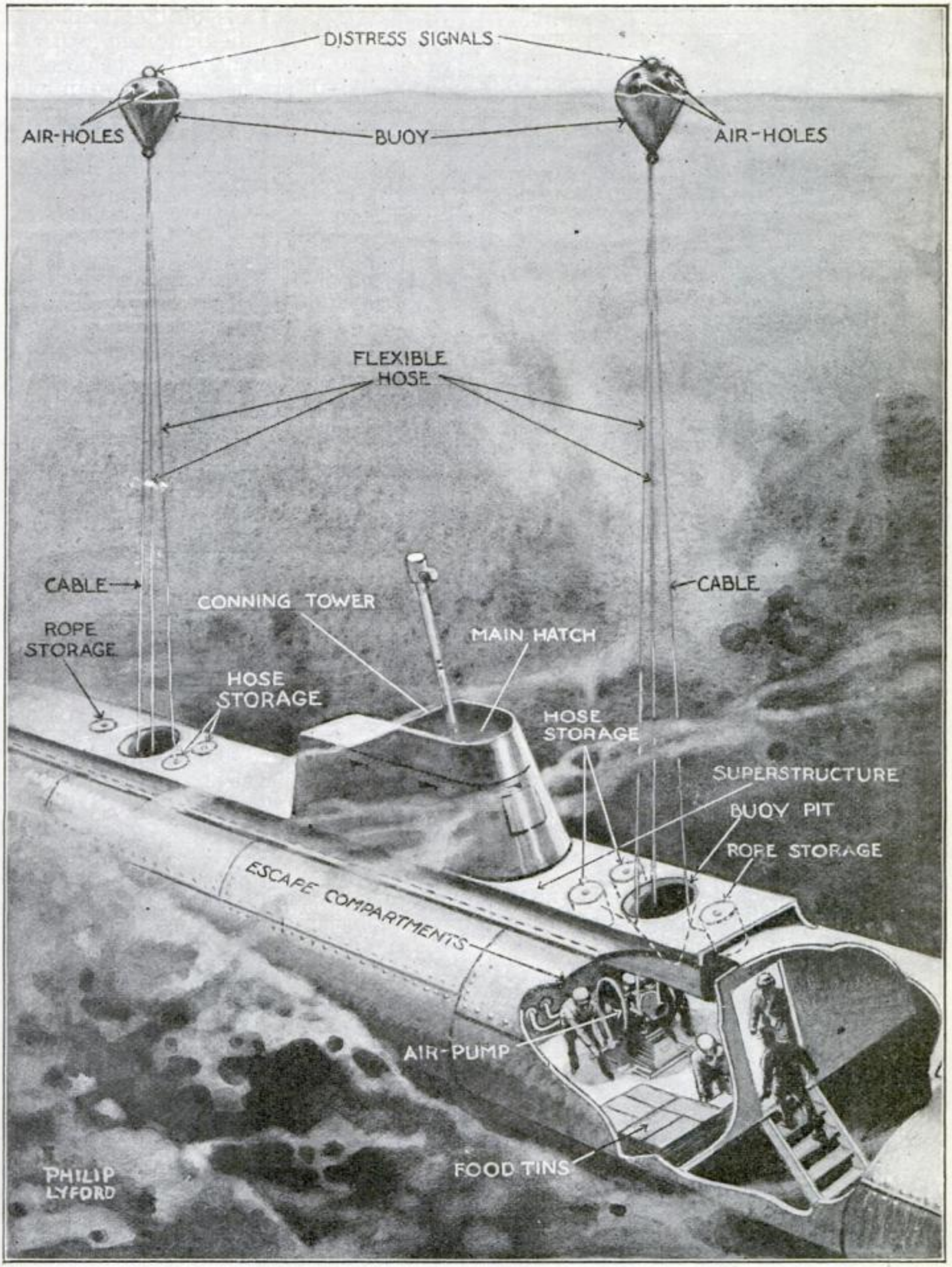
In an emergency in this submarine, the crew put on light diving jackets, escape to the top of the boat through the compartments and hatches, and climb to the surface on the cable attached to a buoy

The manner in which the oxygen is supplied from these suits is extremely interesting. A small cylinder strapped to the back of the wearer contains the oxygen, which is stored at an enormous pressure of one hundred and fifty tons per square foot. The oxygen is slowly released from this by an automatic ejector which regulates its pressure as it is supplied to the body so that it nearly equals that caused by the ocean outside. After the oxygen has been consumed, it is thrown off by the lungs as carbon dioxide, and this the lungs force into a cartridge of chemicals where it is completely absorbed. After this absorption, only the nitrogen of the air remains, but this is again passed over the ejector and mixed with fresh oxygen before it enters the lungs once more. In this way the same nitrogen is used over and over again.

In a third class of devices, the men do not leave the submarine at all. Two buoys are fitted in the superstructure at both ends of the submarine. Attached to each are a cable and two flexible hose, while directly under the point where each buoy is held on the submarine is a compartment into which the crew get in time of danger. Then the buoys are released. As they rise, they carry the cables and hose with them. An unlimited amount of fresh air can now be had by working air-pumps which are connected to the lower ends of the hose.

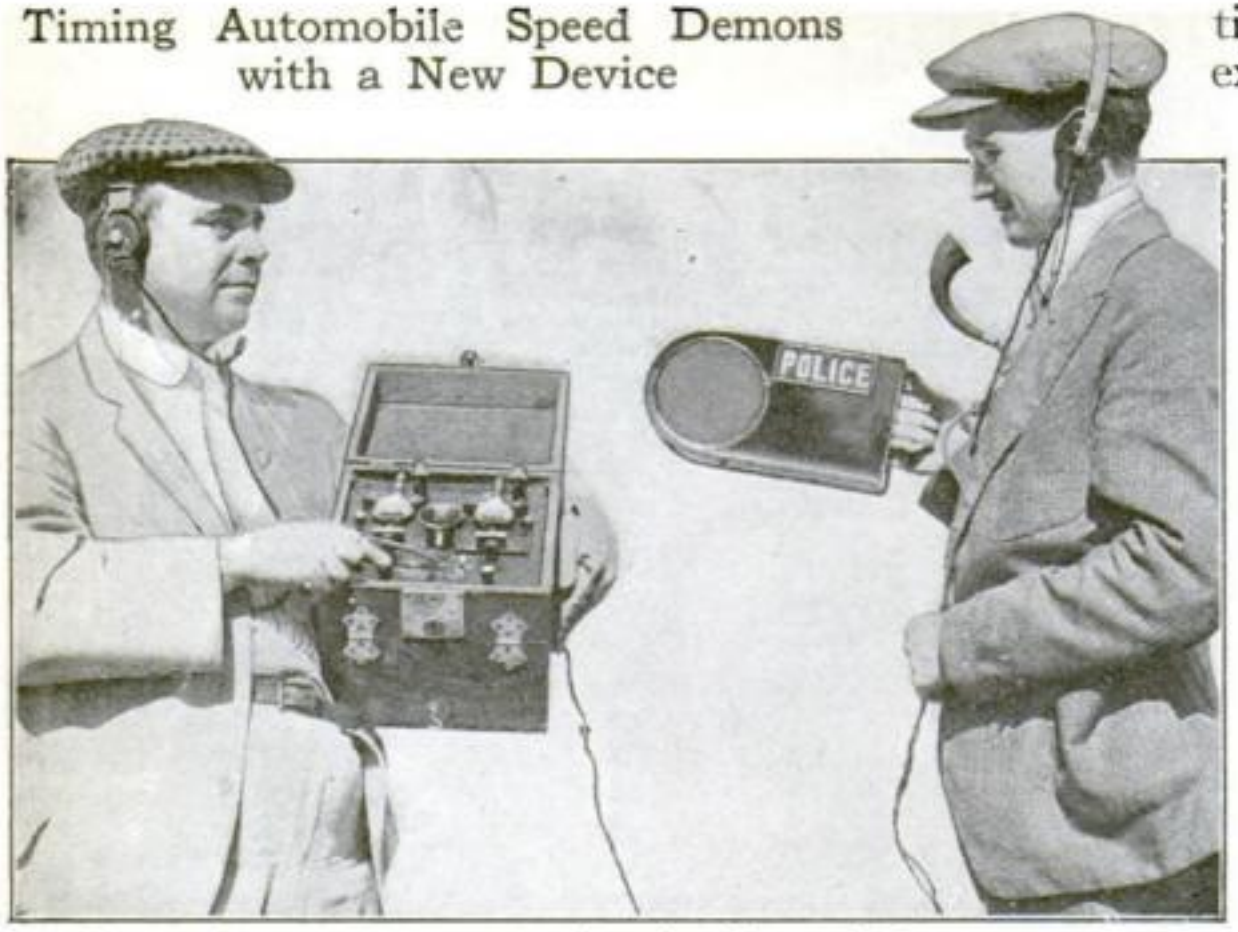
In the two compartments, the men must stay imprisoned until a salvage vessel answers their distress signals, given out by an electrical flashlight within the buoys.

Signaling for Help with Flashlight Buoys



The crew get into the compartments and release the buoys. Until their distress signals are answered, they receive a supply of fresh air through the hose attached to the buoys. On the arrival of a salvaging ship, the submarine is hauled up by means of the cables and the men are freed

Timing Automobile Speed Demons with a New Device



The end operators are equipped with push-buttons and telephones connecting with the stop-watches at the central station. A third man flags the offender with an illuminated signal

IF THE invention of E. H. Pendleton is widely introduced, automobile drivers may no longer break the speed laws and escape punishment through lack of evidence. Pendleton's device consists of a neat wooden box containing a telephone, two push-buttons, and two stop-watches, regulated to the tick of a second. The three men required to operate it are located along a given road at points six hundred and sixty feet apart. An operator is stationed at the central point with the instrument. End operators have telephonic communication with this central station, and are also equipped with push-buttons connected by electric wires with the stop-watches at the central station.

When an automobilist who is going faster than the law allows, approaches from either end, the operator presses the push-button, and the stop-watches six hundred and sixty feet away are set in motion.

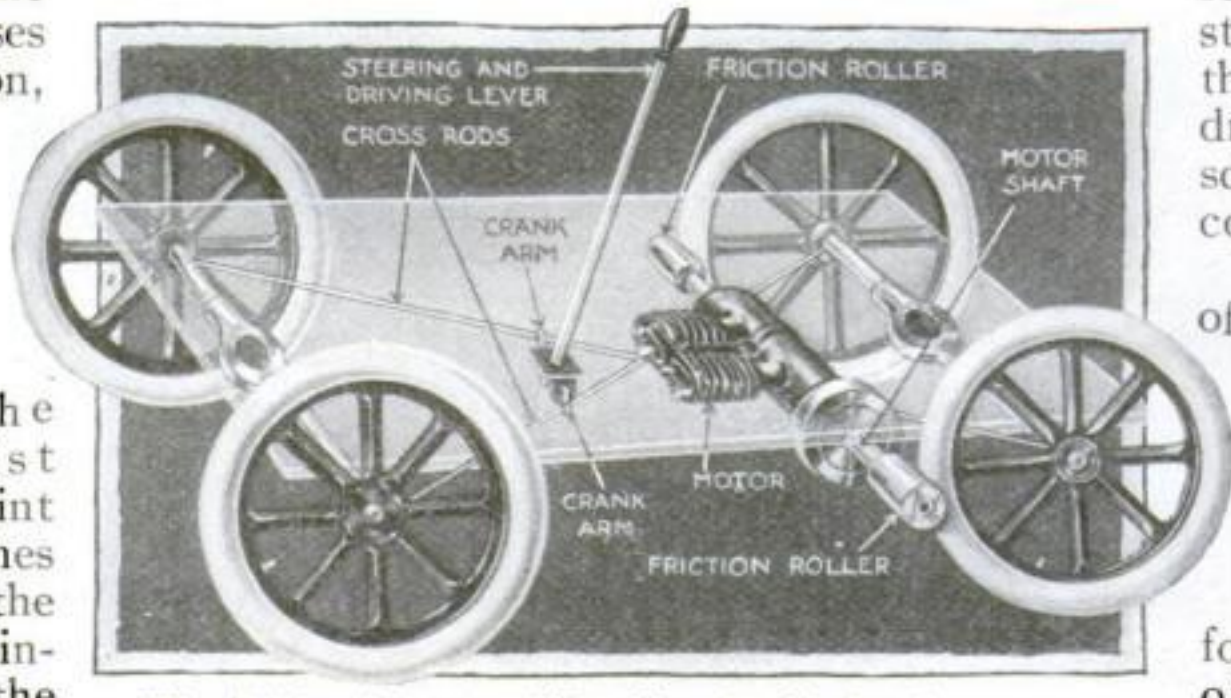
When the automobilist reaches the point where the watches are located, the operator there instantly stops the watches, thus registering the time. If the speed limit has been exceeded, the central operator, by means of the telephone, orders the third man to arrest the speeder. This he does by displaying a red lantern and illuminated sign, reading "Police." As a rule, the motorist has no idea that he is being timed until he is "flagged" and arrested.

A number of cities on the Pacific Coast have adopted the system, one of which in one day collected fines amounting to over half the purchase price of the system.

Novel Method of Drive for Light Cycle-Cars

DRIVING through the peripheries of the rear wheels and steering through pivoted axles, the novel method of combined driving and steering shown in the accompanying sketch should prove of value to the designers of light cycle-cars and the like. The driving is accomplished by the friction between the rear wheels and metal drums on the opposite ends of the motor crankshaft, which is carried crosswise of the vehicle frame. The steering is done through the use of pivoted axles front and rear, the opposite ends of which are connected by two cross wires manipulated by means of a crankshaft and arms fastened to the vehicle frame.

In turning corners, the friction drum on the outside of the curve is released from its contact with the rear tire, while that on the inside of the curve presses with greater force against its tire. Brake action is secured by constructing each of the metal friction drums of two telescoping parts with coned surfaces. The outer part of the drum, which is cylindrical on the outside where it comes into steady contact with the tire, is forced in or out of the clutch-action by means of a fork.



The driving is accomplished by the friction between the rear wheels and the metal drums of the motor crankshaft, which is carried crosswise of the frame

Wigwagging with Hand Flags

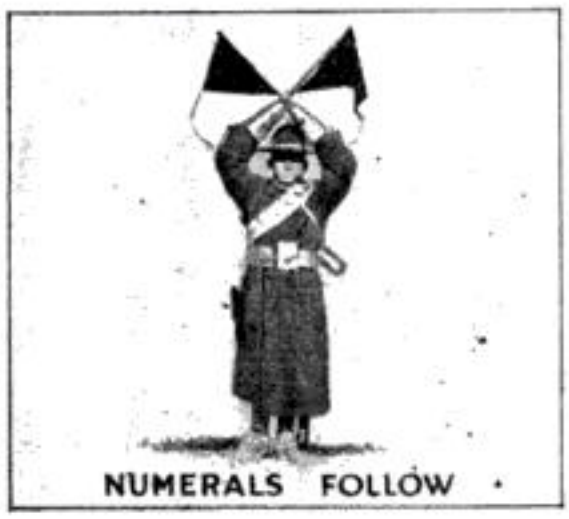
How the army talks over hills and valleys

ALTHOUGH their application is limited on account of their small range, the use of hand flags for signaling is authorized by the United States Army. They are chiefly serviceable for incidental signaling or for use within organizations or fixed stations. The range is seldom more than a mile with the naked eye with flags of usual size, and is dependent upon light and background. But the system is simple and rapid and should be familiar to all soldiers. It is limited to visual signaling and is not adapted to general work as is the General Service Code, although it has been found very useful for special work when rapid communication at short distances is necessary.

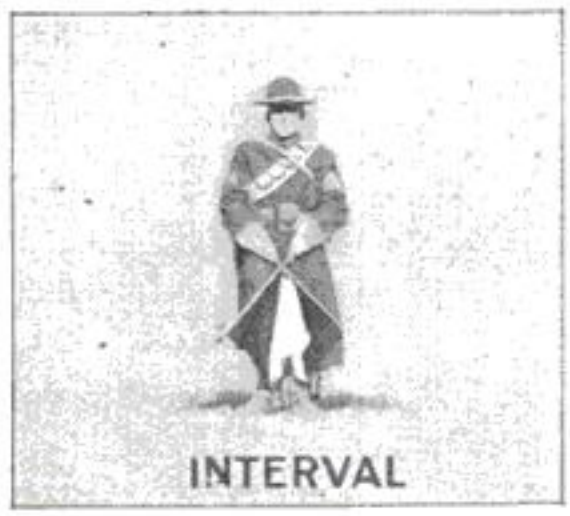
The semaphore hand flags for service use are eighteen inches square, divided diagonally into two parts, one red, the other white. The staffs are twenty-four inches long. For the field and coast artillery there is now issued a semaphore hand flag of orange with a scarlet center and scarlet with an orange center, one of each constituting a kit. The flags are eighteen inches square, the centers nine inches square and the staffs twenty-four inches long.

Hand flags are used in the same manner as the semaphore machine, except that in making the interval the flags are crossed downward in front of the body, just above the knees. This method of signaling is used to advantage within batteries of the field artillery and regiments of infantry and at times is used by the cavalry. It has been highly developed in the Navy. The hand flags of the Navy are from twelve to fifteen inches square, of blue with a white square, or red and yellow diagonally, the colors depending upon the background. The flags are usually attached to a light wooden staff about two feet long.

ATTENTION



NUMERALS FOLLOW

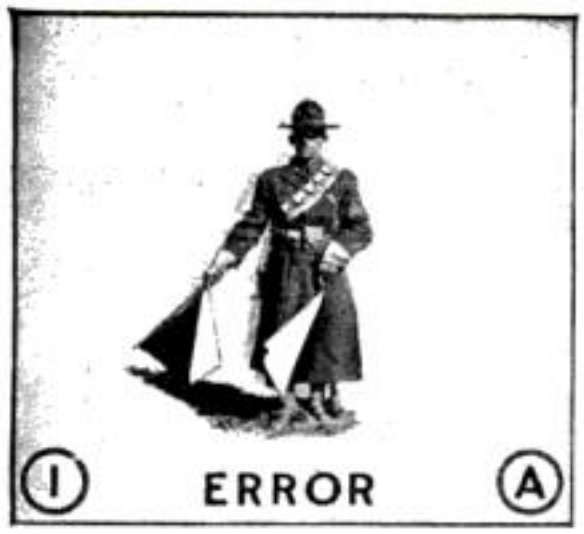


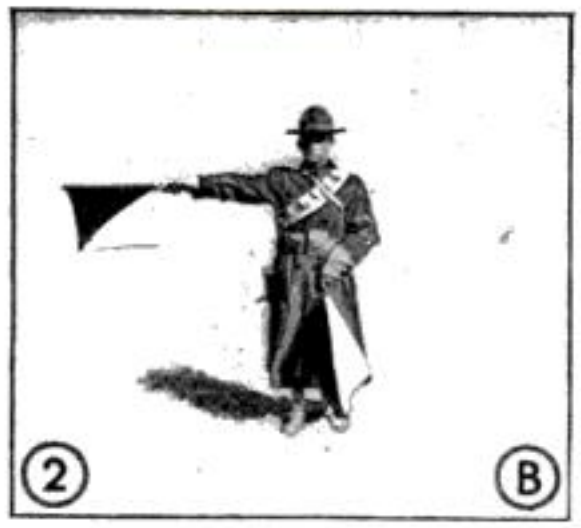
INTERVAL

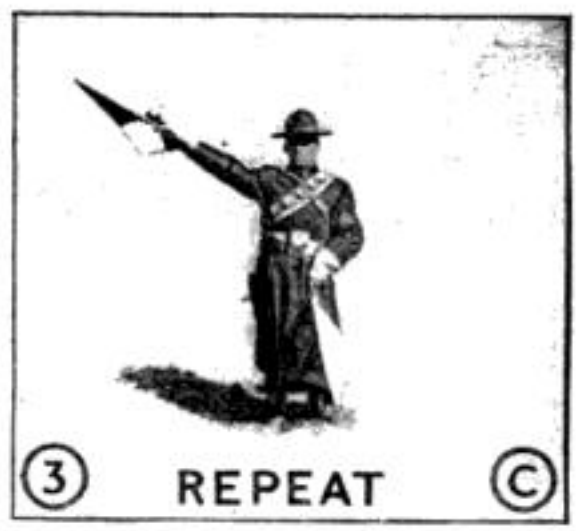
Care must be taken with hand flags to hold the staffs so as to form a prolongation of the arms. With the two-arm semaphore both arms move simultaneously, and there is a pause at the end of each letter

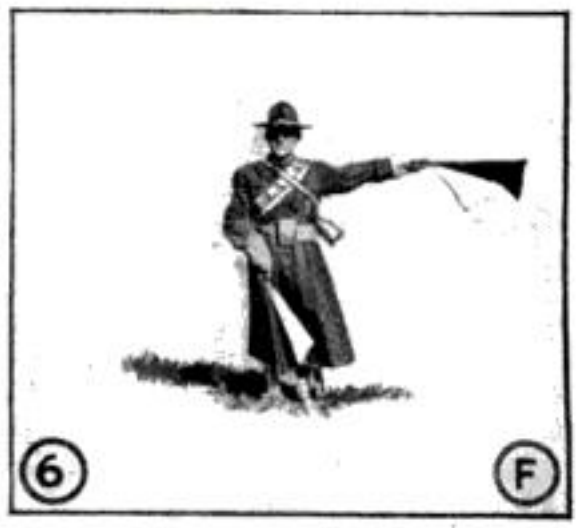
Signaling by two-arm semaphore in the Navy is very similar to hand-flag wigwagging. The ordinary machine or stationary semaphore is also authorized for general use by the Army at the present time. With the machine a third arm or indicator is displayed on the right of the sender, which is the left as viewed by the receiver. At night a red light screened to the rear indicates the direction of sending.

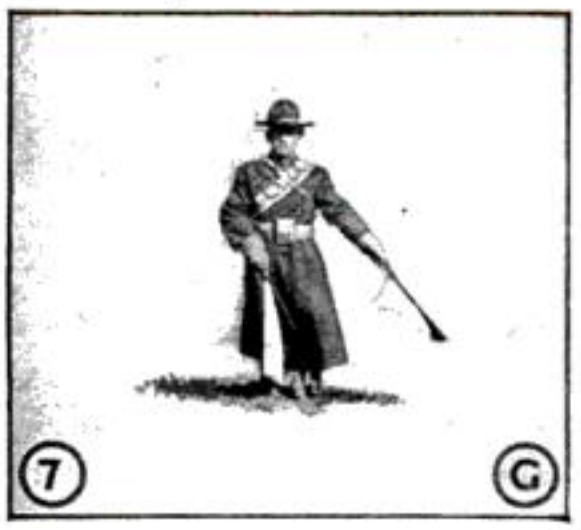
The machine is mounted at some available point so situated that it may be seen through the greatest arc of the horizon. By means of electric lights installed on the vanes, the machine is made available for night as well as for day signaling. This method is the most rapid for sending spelled-out messages. It is, however, very liable to error if the motions are slurred over or run together in an attempt to make speed. Both arms move rapidly and simultaneously, and there is a perceptible pause at the end of each letter before making the next letter. When communicating with the Navy numerals are always spelled out. In using the machine signal, men are taught that rapidity is secondary to accuracy.



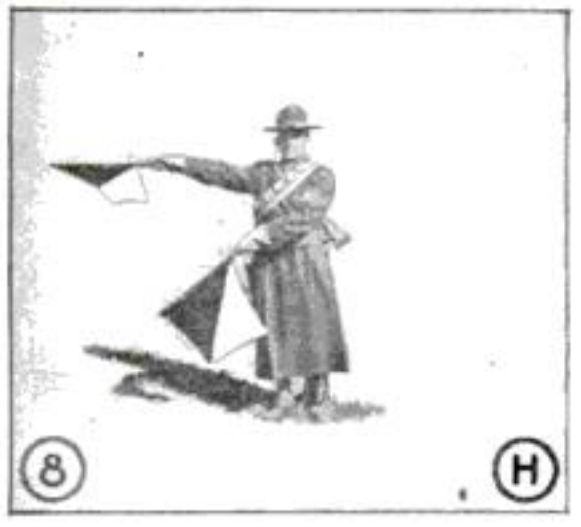


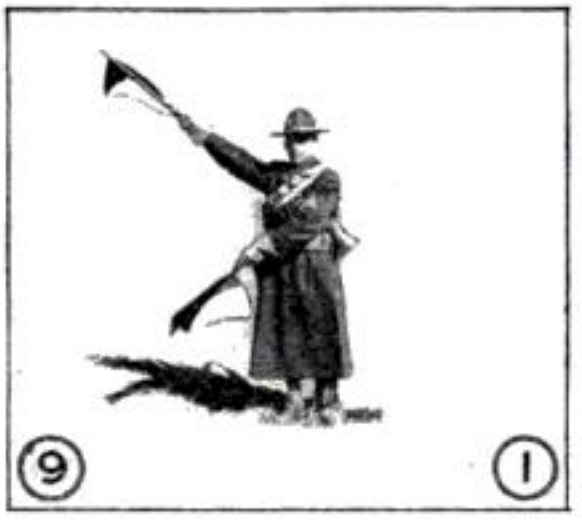


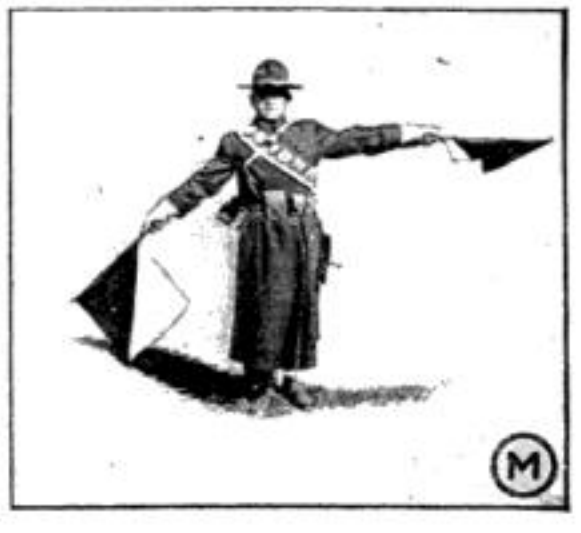




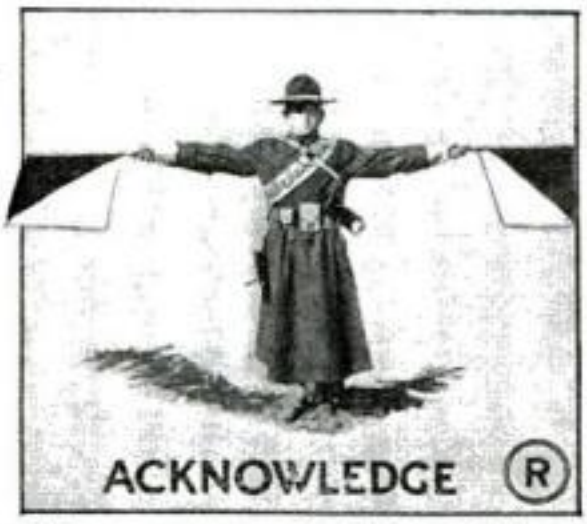
To call or answer: "Attention" followed by call letter of station called. Repeat as necessary. Both stations then make "Interval"
Repeat last word: CC "Interval" twice
Repeat last message: CCC "Interval" three times
Repeat after (word): CC "Interval" A (word)
End of word: "Interval"
End of sentence: "Chop-chop" signal. To make this, both arms are placed at the right horizontal and then moved up and down in a cutting motion
End of message: Two successive "chop-chop" signals and withdrawing the flags from view
Error: AA—"Interval," then repeat word
To break in: "Attention"

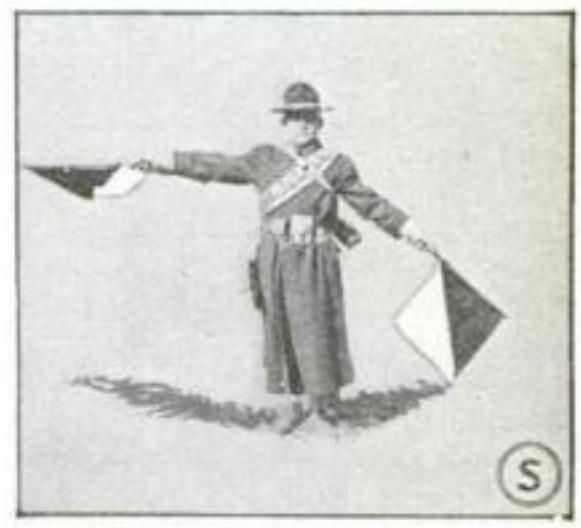






Instructions for Wigwagging with Flags





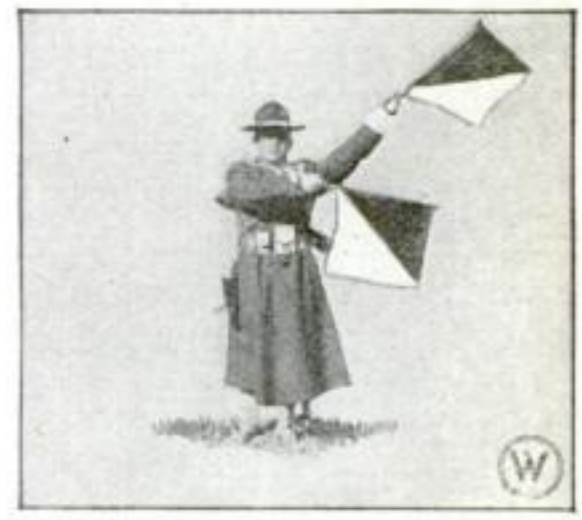
"Negative," "Affirmative," or "Interrogatory" followed by "Interval" give corresponding meanings to the following signal

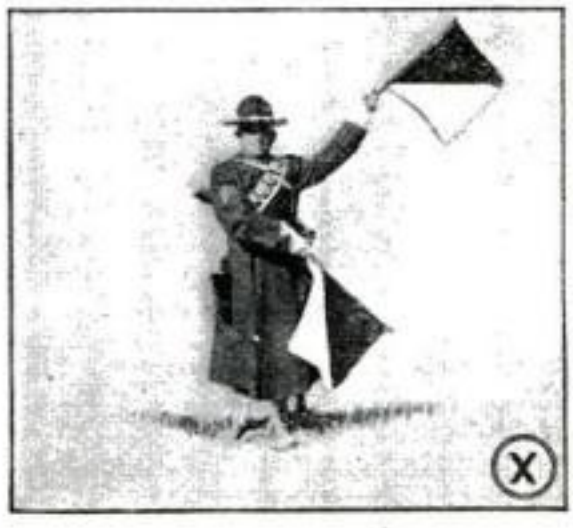
Receiver acknowledges "Attention" whenever made, also "Repeat," etc., and end of message when latter is understood

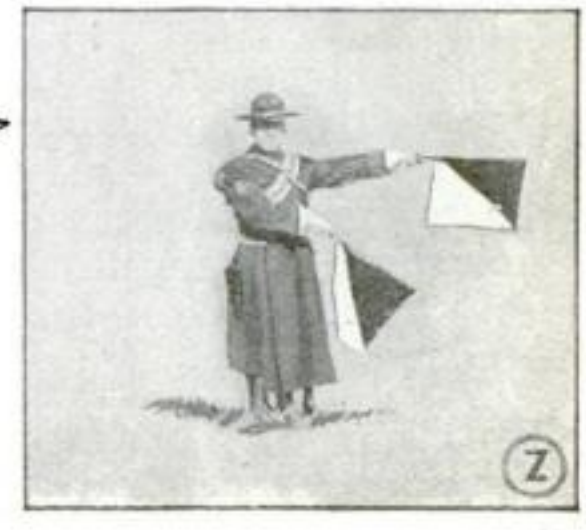
While waiting for "Acknowledgment," or in case of delay remain at "Interval"

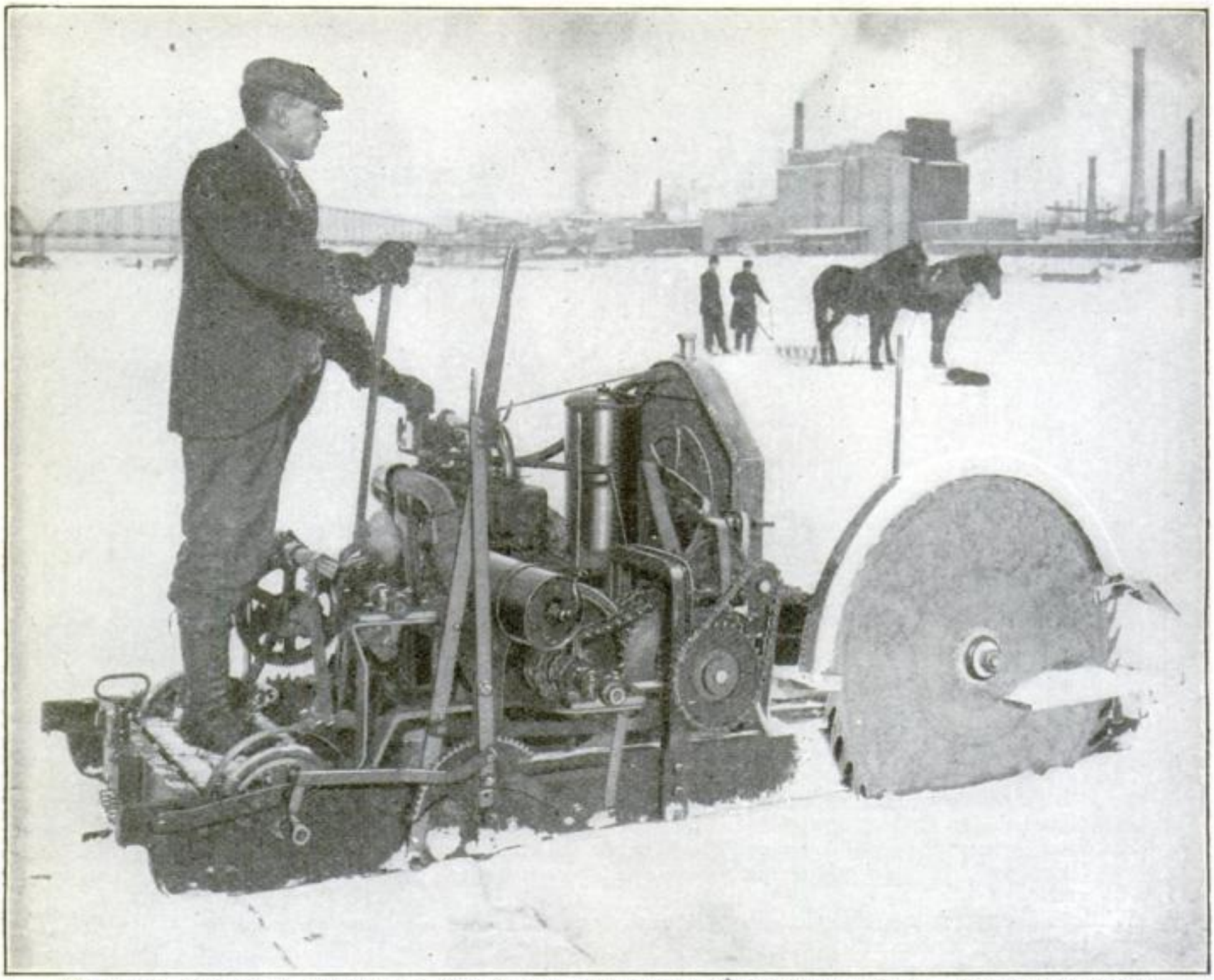
Words not in code are spelled out

"Numerals" precede every number sent and indicates numerals until "Interval" is made, after which letters recur without any further indication. When numerals follow letters no intervening "Interval" is necessary. The numerals are the first ten letters in order. When communicating with the Navy numerals are spelled out









The saw is geared directly to the motor and works in either direction. It will cut thirty thousand cakes of ice per day, thus equaling the work of sixteen men with eight horse-teams

This Ice-Cutting Machine Takes the Place of Eight Horse-Teams

EQUIPPED with a thirty-five horse-power gasoline motor, which both drives the machine and operates the cutting saw, a new type of ice-sawing machine has been put on the market by a western manufacturer. It will cut one cake of ice a second, or thirty thousand cakes a day, thus equaling the output of sixteen men and eight horse-teams.

The machine is one of the few gasoline ice-sawing machines in the field at the present time, which can be run in either direction with equal success. Spiked wheels driven by gears and chains from the motor move the machine over the ice, and the single large ice-saw may be raised or lowered to cut to a depth of from six to sixteen inches according to the thickness of the ice. The speed of the apparatus is regulated by means of a friction disk similar to that used on some automobiles. The saw is geared directly to the motor and cuts in either direction. Since the machine can cut in either direction, it is not necessary to turn it around at the end of a cut, but merely to shift it back.

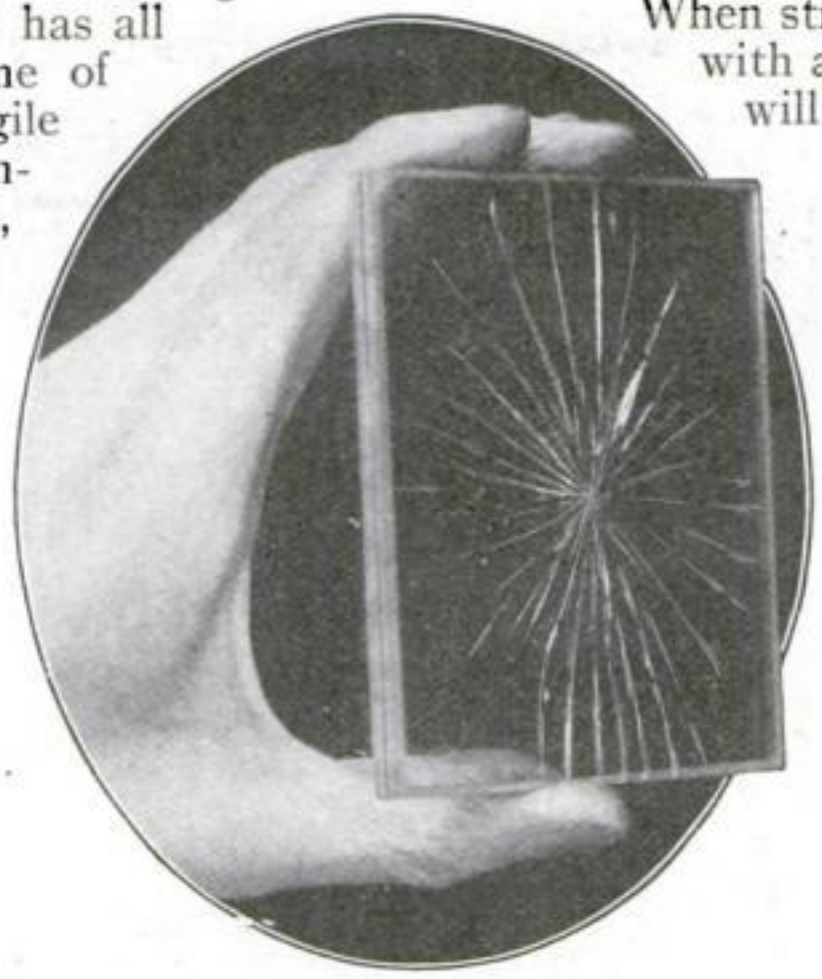
Taking Care of Automobile Tires at the Front

IN THE early days of the war the wastage of automobile tires in France was alarming. The suddenness and the extent of the effort necessary to stem the tide of invasion put economy out of the question. Tires were abandoned as soon as they were damaged and claims for new ones were never questioned. The drivers had neither time nor tools for making repairs, in most cases. But now each driver works from a base or depot, to which the worn or damaged tubes and casings must be returned. From the depot the damaged tires are sent to central repair stations where they are repaired, tested, dried, talced and packed in cardboard boxes marked with all necessary descriptive data. These repaired goods are stored in special storehouses and distributed as needed.

A Wonderful New Glass Which Cannot Be Shattered

A NEW glass, transparent, tough and strong, which has all the advantages and none of the defects of brittle, fragile window glass, has been invented by Frank Shuman, of Philadelphia, whose earlier inventions include wire glass, a widely used form of concrete piling, and the sun power plant erected at Maadi, near Cairo, Egypt.

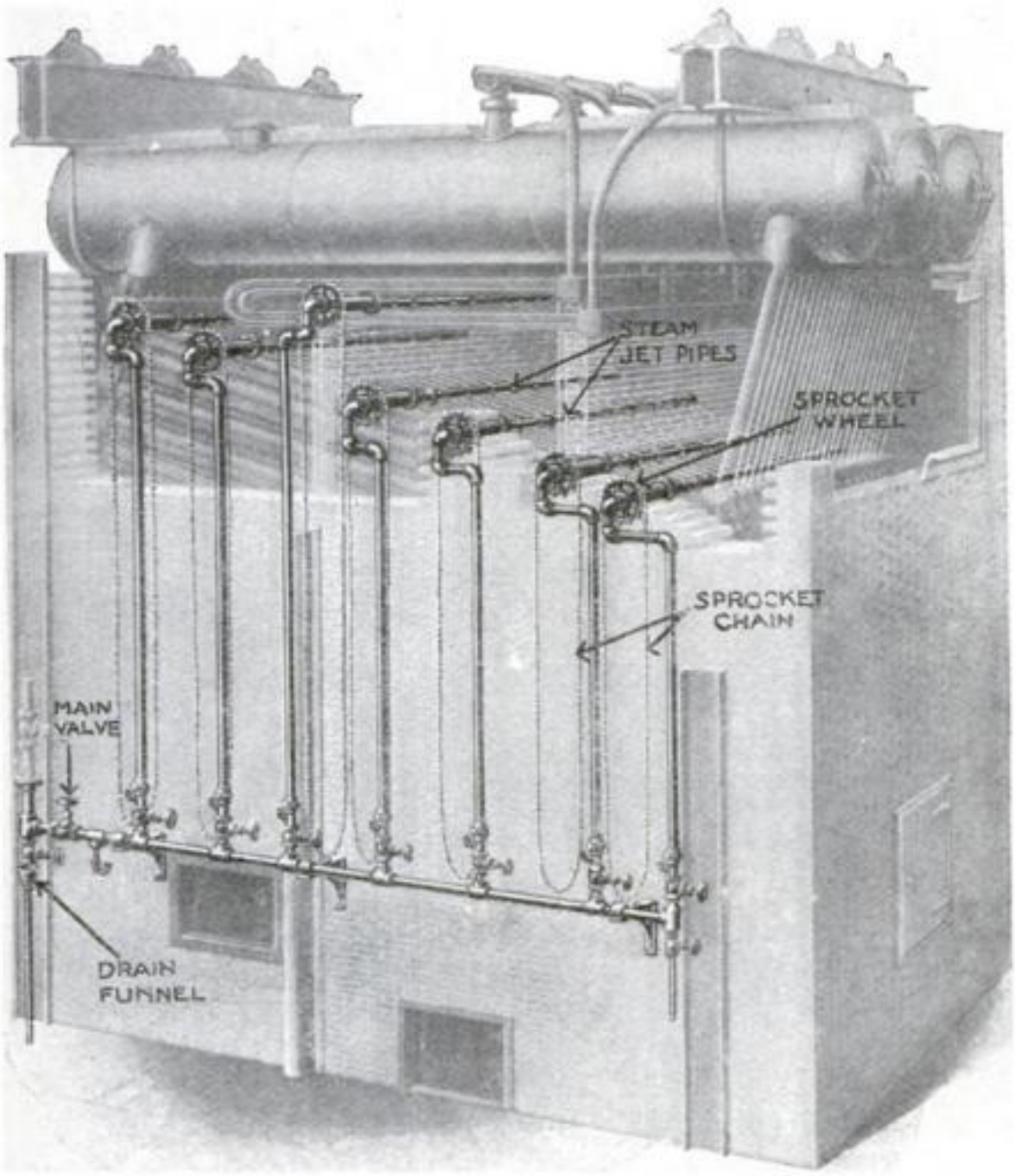
A twenty-two caliber bullet cannot penetrate the new glass; a brick cannot shatter it; a heavy man thrown against it under all the terrific momentum of a collision would not go through it, but would be thrown back from it, uninjured by flying glass, because none would fly. A stone thrown against it will bounce back like a golf ball.



A sharp blow with a hammer may crack the glass but will not shatter it into splinters

When struck a powerful blow, as with a hammer, for instance, it will crack into hair lines, as shown in the accompanying illustration, but there will be no shower of flying glass or splinters. Furthermore, these hair-line cracks leave the surface absolutely smooth.

The secret of its strength is a sheet of white, transparent celluloid, twenty-one thousandths of an inch thick, which is placed between two pieces of glass. The glass and celluloid are simply welded together under high temperature and tremendous pressure, the resultant being a solid sheet possessing all the transparency of the best plate glass, combined with the strength of a sheet of metal.



A boiler can be blown clean in six minutes. If cleaned once in every six hours it will increase five per cent in efficiency

Preventing Boiler Troubles by Mechanical Cleaning

THE shortcomings and difficulties connected with the hand-cleaning of modern steam-boilers have resulted in the development of the mechanical steam-blower, the latest and most effective type of which is shown in the illustration. It employs nozzles arranged across the width of the boiler, so that all surfaces are equally accessible and soot cannot be blown from one part of the boiler to another.

Two cleaner-elements are mounted on bearings and rotated by a chain and sprocket-wheel outside the setting. The jets of steam are directed along diagonal paths, one in one direction and the other in the opposite direction. When they are discharged into the passages between the tubes, the cleaner is slowly rotated, back and forth over a wide arc.

Why Do We Grow Bald?

Disease and tight hats are not the chief causes. Baldness can be inherited, like other traits

By D. Osborn, Ohio State University

IT IS popularly supposed that some forms of baldness are caused by the wearing of tight hats. Often the line of baldness seems to coincide with the hat-band, which might show that it is cutting off the supply of nourishment to the scalp. One of the main arguments in support of this theory is that women do not become bald.

In making a study to determine whether heredity is an important factor, I considered only pattern baldness. By pattern baldness is meant the kind associated with thin, normal or heavy hair. It usually does not put in its appearance until after the twentieth year. Among the various patterns the most common are complete baldness on the top of the head; that involving only the crown; that giving the appearance of an extremely high forehead, and that covering the top and back portions of the head.

Obviously the line of baldness here does not coincide with the hat-band

In one family the father was bald before he was thirty. His only son showed the same baldness pattern at birth, but later grew a normal head of hair, which he retained until the past year. Now at twenty years of age the hair is beginning to fall out in the same fashion that his father's did. This indicates that the baldness pattern may be plainly defined at birth.

In two families which were studied, no baldness whatever could be found. Heavy hair predominated and was retained to an advanced age. Tight hats were worn by the men, but neither the hats nor severe illness had affected the luxuriance of the hair.

The families which were traced in reference to baldness show clearly that it is inherited. Contrary to the prevalent belief, women do become bald. They are more sensitive concerning it, and can more easily conceal it than men. However, there are fewer bald women than bald men, due to the method of inheritance. Pattern baldness is called a "sex-limited trait." The characteristic is transmitted directly from father to son and may be inherited through the mother, though she herself is not bald. A bald man may transmit the trait to his daughter, who though she does not show it herself can transmit it to her children. A woman of this type is called a carrier. If a woman inherits the tendency to baldness from both parents she herself becomes bald. Inheriting the tendency from both parents does not necessarily mean that both parents must be bald, but that the father is bald and the mother a carrier. A bald woman must inherit double the tendency that a bald man inherits.

The man on the right is thirty-five years old. The one on left is fifty. The patterns of baldness are distinctly different

That women may behave as carriers of baldness explains why it may skip generations and ap-

pear in a family suddenly. The carrier tendency can be transmitted from mother to daughter so that baldness itself might not show for many generations. In the long run half the sons of a bald man or a woman carrier will be bald and half of the daughters carriers. If the mother is bald all of the sons will be bald and all of the daughters carriers. Illness will occasionally cause baldness in women when there is only the single inherited tendency. In a case of this kind not all of the sons will be bald. Where there is no tendency to baldness the hair may fall out from poor health, but afterward it is regained.

Father and daughter aged sixty and twenty-two. Both have luxuriant hair, although the father lost his in youth through fever

A Bicycle Which Won't Let You Lose Your Balance

AN APPARATUS has been invented by Eugene Tourtier, of Paris, France, which gives bicycles, motorcycles and every other similar vehicle a vertical equilibration regardless of whether or not the road is level. It is merely necessary to support the machine in an upright position by operating a lever attached to the handlebar.

The lever can be operated while the bicycle is moving, making it possible for a rider to remain in his seat as the wheel comes to a stop and to start again without dismounting.

The apparatus consists of two steel-rod supports pivotally attached to the rear frame of a bicycle or motorcycle, and a strong, flexible wire which leads from the supports to the lever on the handlebar. The supports may be forced downward as the bicycle moves, causing it to stop quickly and holding it upright and steady when it does stop.

The steel rod supports are strong enough to sustain a combined weight of eight hundred pounds

Cork Fabric for Featherweight Raincoats

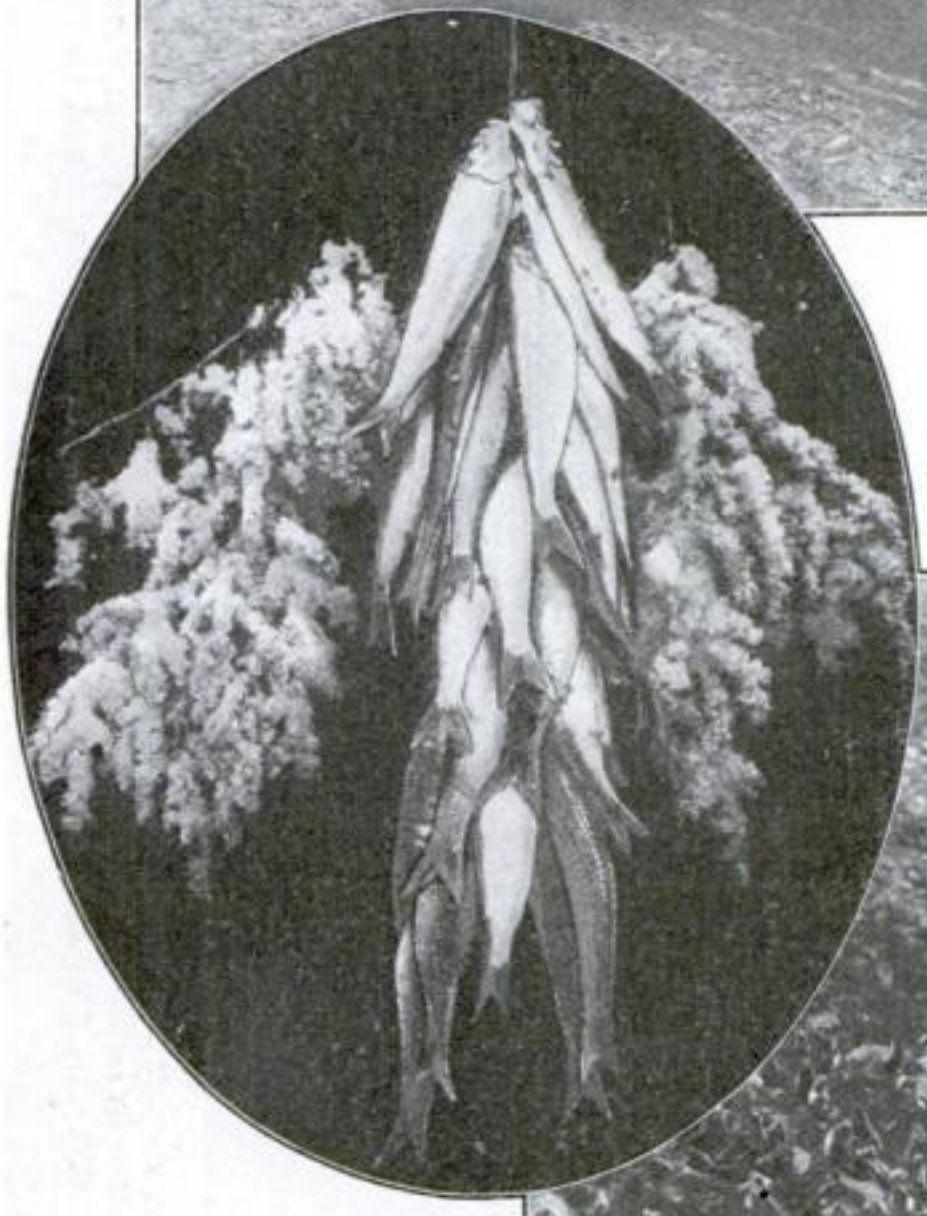
CORK fabric is a recent French production, the result of a new French process. It is waterproof, a non-conductor of heat, and unbreakable. By using a special machine, thin slices of cork of an even thickness are obtained from a block of cork. The slices are placed in chemical baths in order to remove the resinous parts which make cork a more or less brittle substance. Upon their removal the cork sheets become flexible and may be compared in this respect with thin leather. In fact, the sheets can be folded and bent without breaking.

By combining the cork sheets with any suitable cloth, preferably a thin and strong cloth of good color, an excellent waterproof material is obtained. An adhesive preparation is employed to glue the cork to the cloth; or, if a stronger garment is desired, the cork sheets are placed between two layers of cloth. The cork fabric has a decided advantage over ordinary rainproof materials because it is porous, permitting ventilation where the ordinary raincoat prevents it. Of course the cork is very light. A coat made of it is said to be the lightest on the market.

Yakutat Indians in native costume for Potlatch Festival. Their entire season's earnings of $4,800 at the canneries were spent in two days of riotous celebrating at these festivities

Below: Gulls waiting to feast on salmon and their eggs. The fish swim to the headwaters, lay their eggs, and retire when the water subsides. This leaves the eggs for the gulls

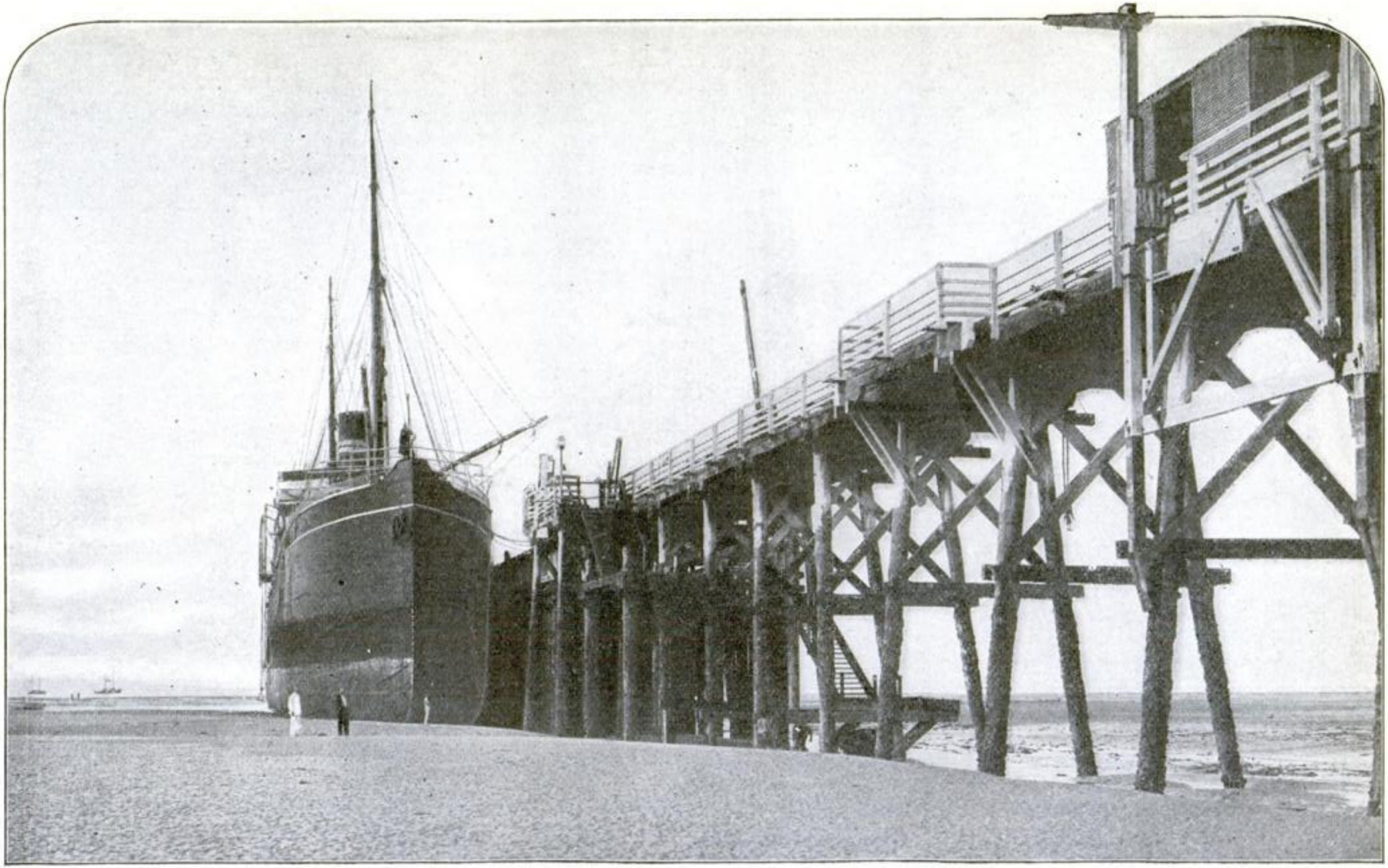
The World With Sixty Million Salmon Annually



Above: A method used by natives near Sitka, Alaska, for drying herring spawn for fertilizer. This means a partial destruction of the future supply of herring from the Alaskan fisheries

At left: Herring and their spawn. The eggs were deposited on branches that had fallen into the water. The herring industry has yet to be developed to its full capacity in Alaska

A seal rookery on St. Paul Island. There is a possible commercial value in seal meat as food in the United States. The meat is not strongly flavored or in any way unpleasant to the taste. At present it is a wasted product, since only the skin has a market value

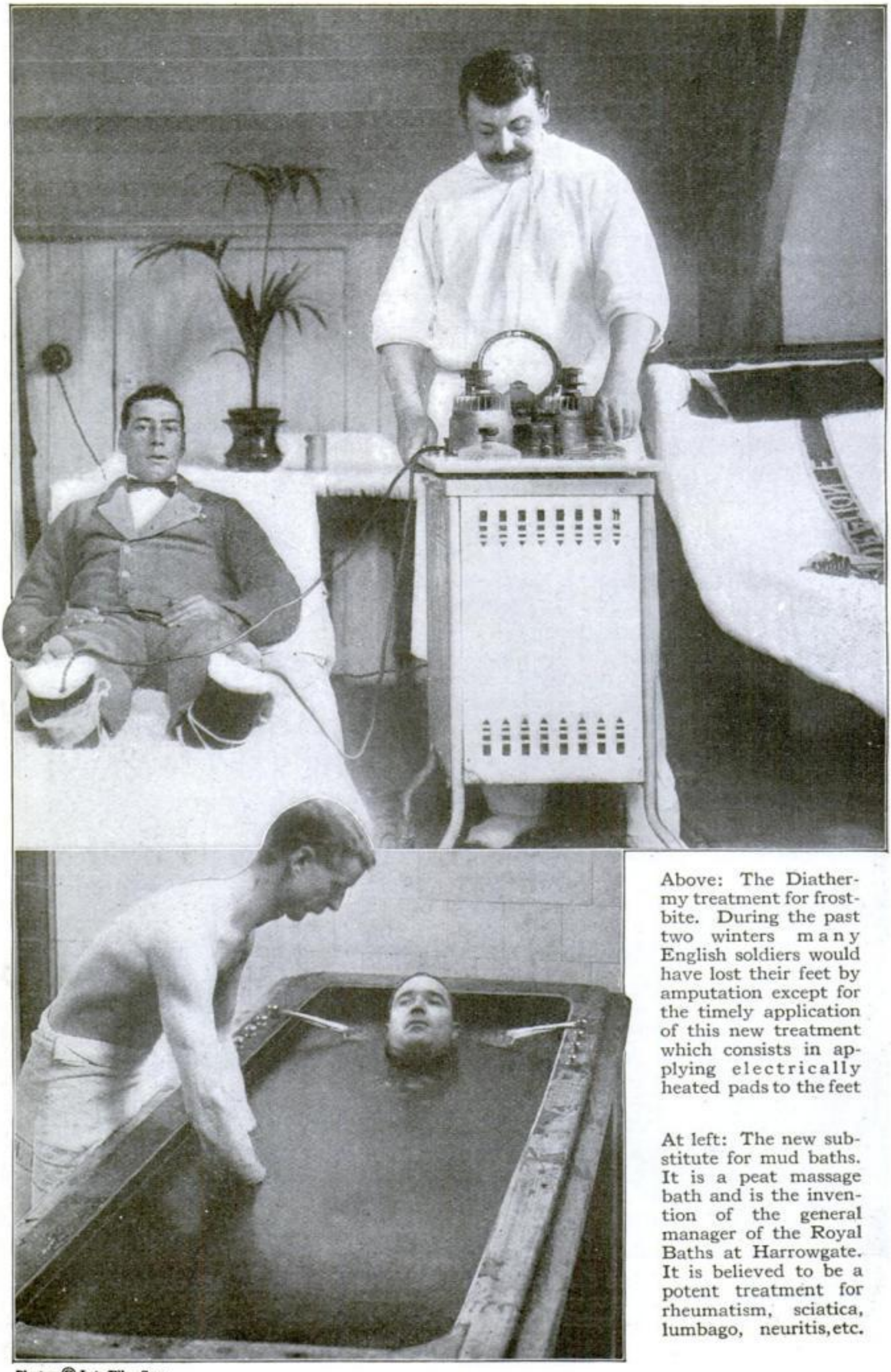


It is not uncommon on the west Australian coast to see several large coasting vessels stranded on the beach adjoining their wharves, waiting for the far-away tide-waters to rush in again before they can put out to sea. The photograph shows a coasting vessel left high and dry at her moorings at Broom, West Australia. In the Bay of Fundy the rushing Spring tides swell to the enormous height of sixty or seventy feet

Trapshooting in the Navy

Sailors on board the United States battleship "Connecticut" shooting the clay pigeons. The trap used is of the hand-operated variety. The Navy shooters have a registered tournament of their own, for which application was made to the Interstate Association

New Cures at the Royal Baths in England

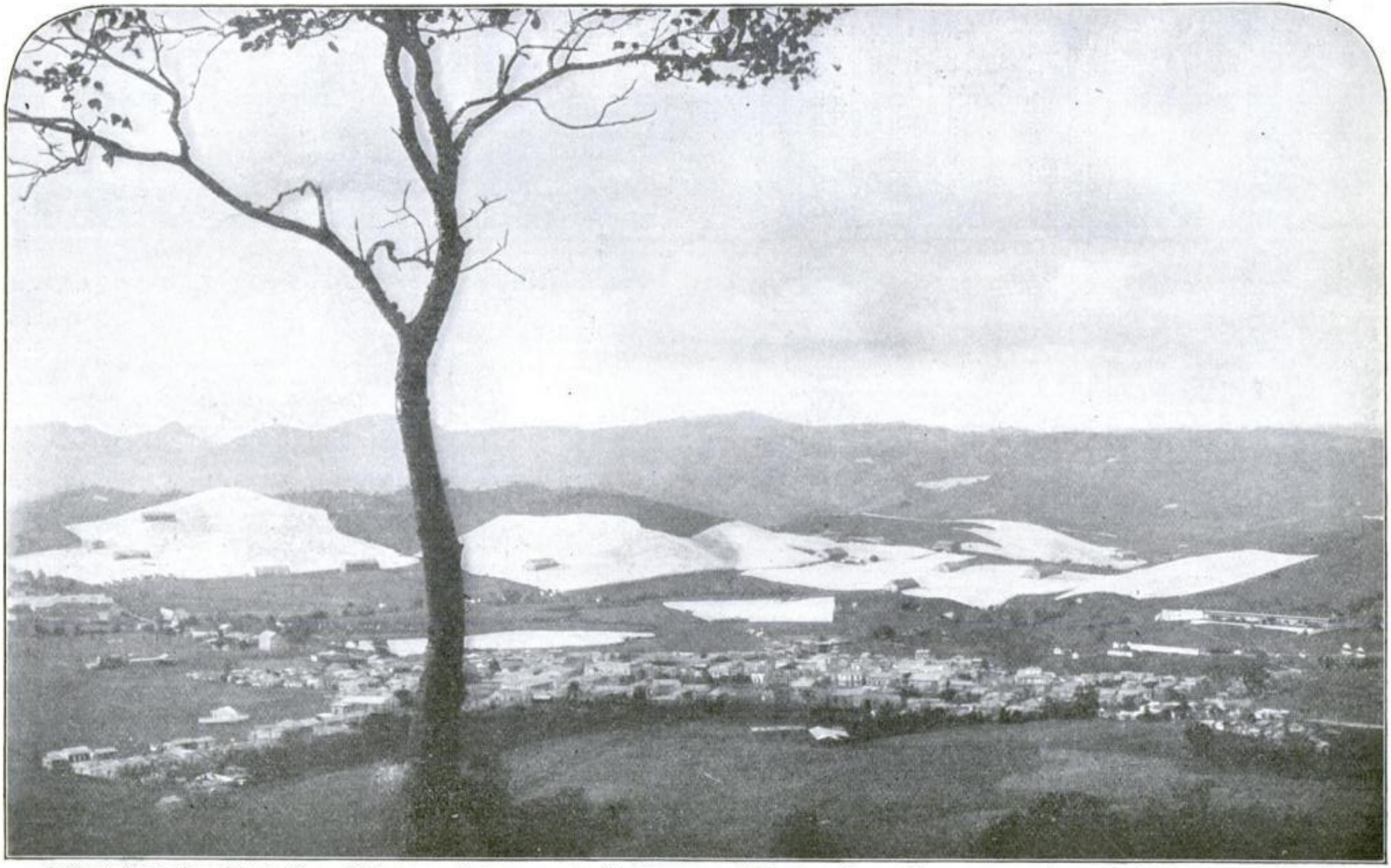


Above: The Diathermy treatment for frostbite. During the past two winters many English soldiers would have lost their feet by amputation except for the timely application of this new treatment which consists in applying electrically heated pads to the feet

At left: The new substitute for mud baths. It is a peat massage bath and is the invention of the general manager of the Royal Baths at Harrowgate. It is believed to be a potent treatment for rheumatism, sciatica, lumbago, neuritis, etc.

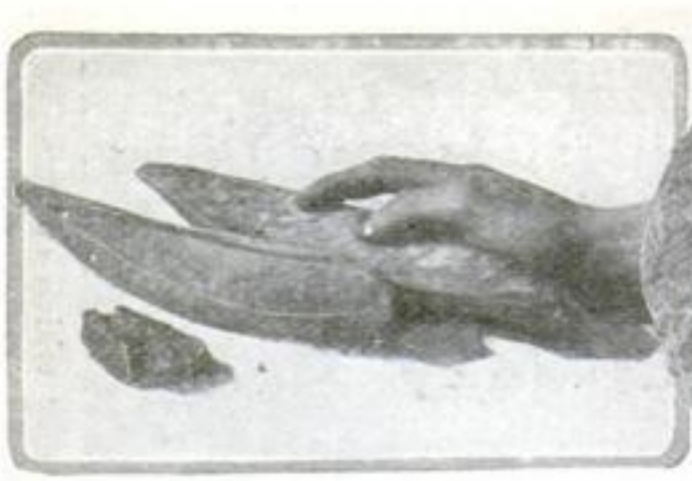
Photos © Int. Film Serv.

Tropical "Snow Drifts" of Cheesecloth



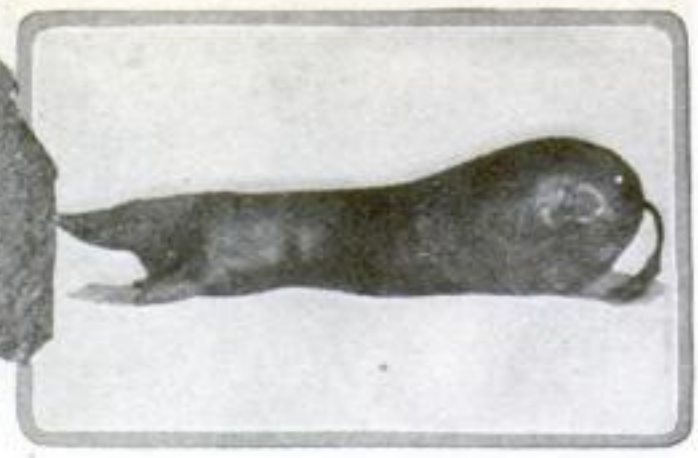
At first glance these Porto Rican hills appear to be covered with huge snow drifts, but these white areas are tobacco fields over which cheesecloth has been spread to protect the leaves from rain and wind. The cheesecloth can be used only once, after which it is sold as cotton waste

Here Are a Few Interesting Things to Eat in a



Japanese mackerel steaks smoked and sun-dried to stone-like hardness. When properly prepared they are juicy snacks, so they say. They resemble knife-sharpening bones in this form

Above: A pound of delicately flavored tea packed and compressed by the bare feet of Chinese damsels



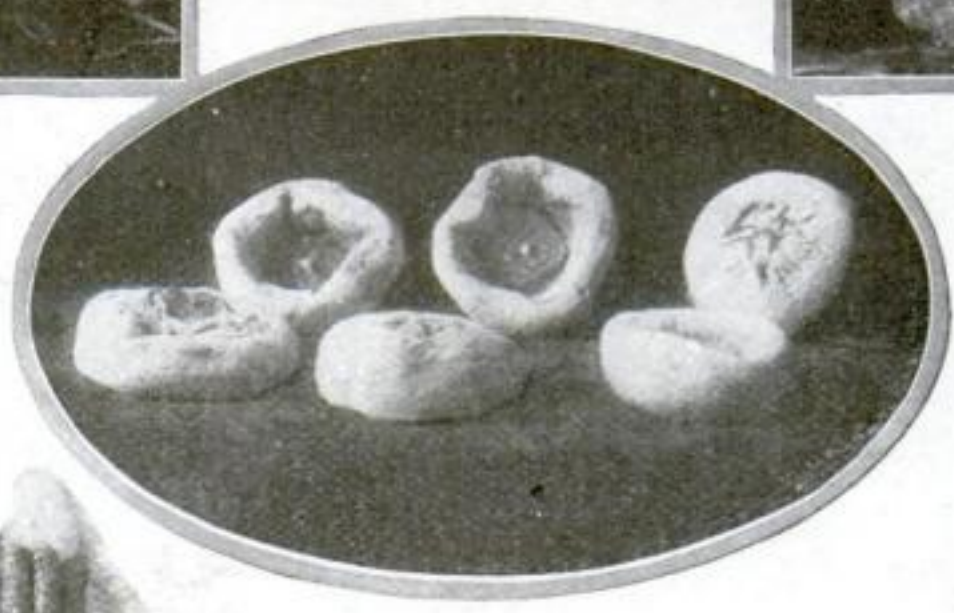
Not a toy but an Italian pig's foot stuffed with ham meat. Everything but the tail of cord is eaten. This is but one of many food-freaks that one finds in a visit to sunny Italy

At right: It looks like a football but it's the sun-dried cuttlefish or devil fish of the Greek coast with suckers intact. The shredded part is more tempting than the tentacles

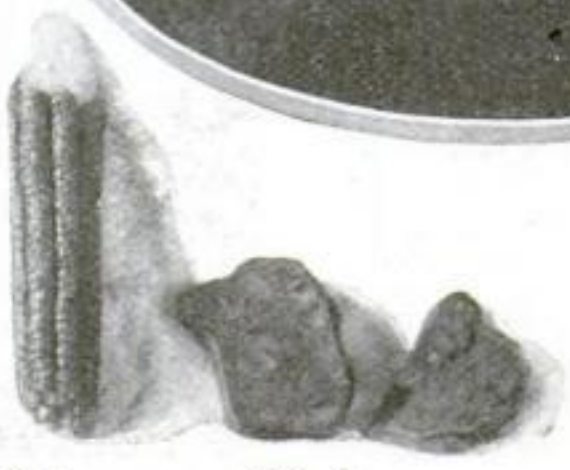
The cuttlefish at the left is of small size. Some are so large that the suckers, when stretched to their full length, can encompass the girth of a half dozen human beings

Below: Sun-dried persimmon fruit of the Orient is the size of goose eggs. Both fruit and shell are eaten after they have been boiled

Above: Sweet butter preserved without a particle of salt inside a gourd-like container made of cheese. The whole remains fresh and edible for years



Above: Lean pork strips sun-preserved without salt in Spain. Deer, buffalo, caribou, bear, goat and tuna meat is preserved in much the same way



Scotch oat-breadstuff in sausage-link form. Mexican corn and black-brown tortillas. Mexico's famed crystalized cactus-pulp is said to be the choicest table delicacy of the west

Sun-dried gizzards of Chinese geese. They are of bone-like hardness but are edible when soaked

Hungry Man's Gastronomic Trip Around the World

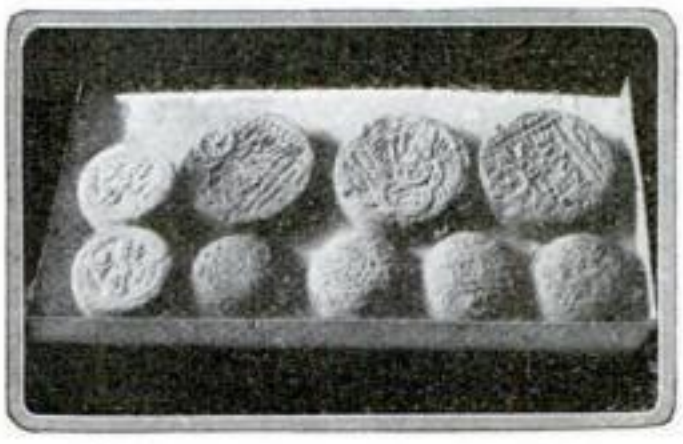
Chinese tree-pith breadstuff strips, tamale, and ripened eggs only twenty-five years old

The pure bean cheese of the Orient is made solely from prepared bean-casein curd

Genuine Turkish caviar in its solid roe form. It is clean to handle and keeps for years

Stringed hazel nuts of the Italians. Below: Sun-dried oysters are a delicacy in China

Cuttlefish preserved in its own ink, the only preserved-in-ink foodstuff known to us

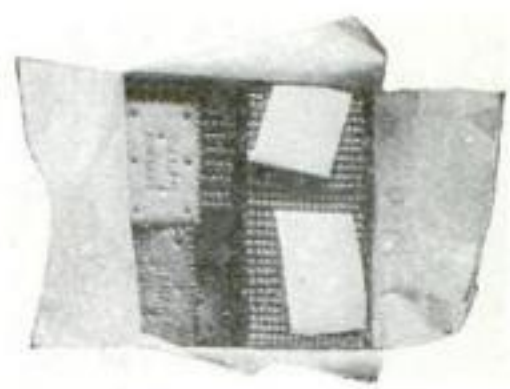


Chinese-Japanese biscuits made of wheat and bean flour

The emergency rations of our soldiers. There are three bread and meat cakes and three pressed chocolate tablets

Smoked pears from central European farmhouses are nutritious when properly stewed

Plum pudding in a bladder container is a great delicacy in southeastern Europe



The banana as a dried breadstuff has been used by numerous races for centuries

Sun-dried beef of Latin America. Some stretch it for tether ropes

Queer Denizens of the Deep

Photograph by American Museum of Natural History

Above: A queer specimen of deep-sea fish which is about twelve inches long and has tentacle eyes each with a phosphorescent bulb attached. At left: A lobster with a double claw. Below is the special kind of louse which torments whales. What would the Popular Science Monthly not give for a picture of a whale scratching himself!

Is this the Origin of Forcible Feeding?

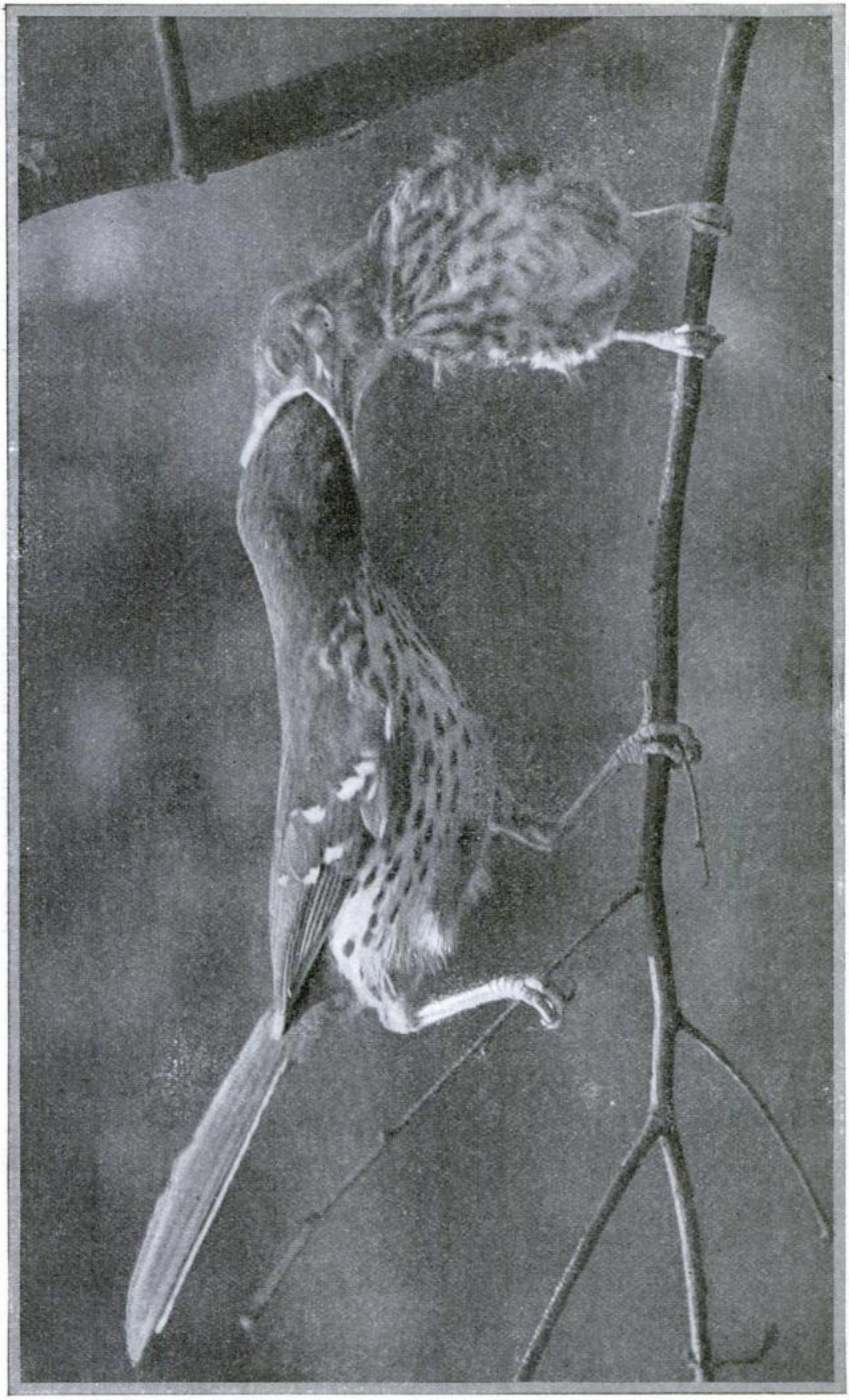
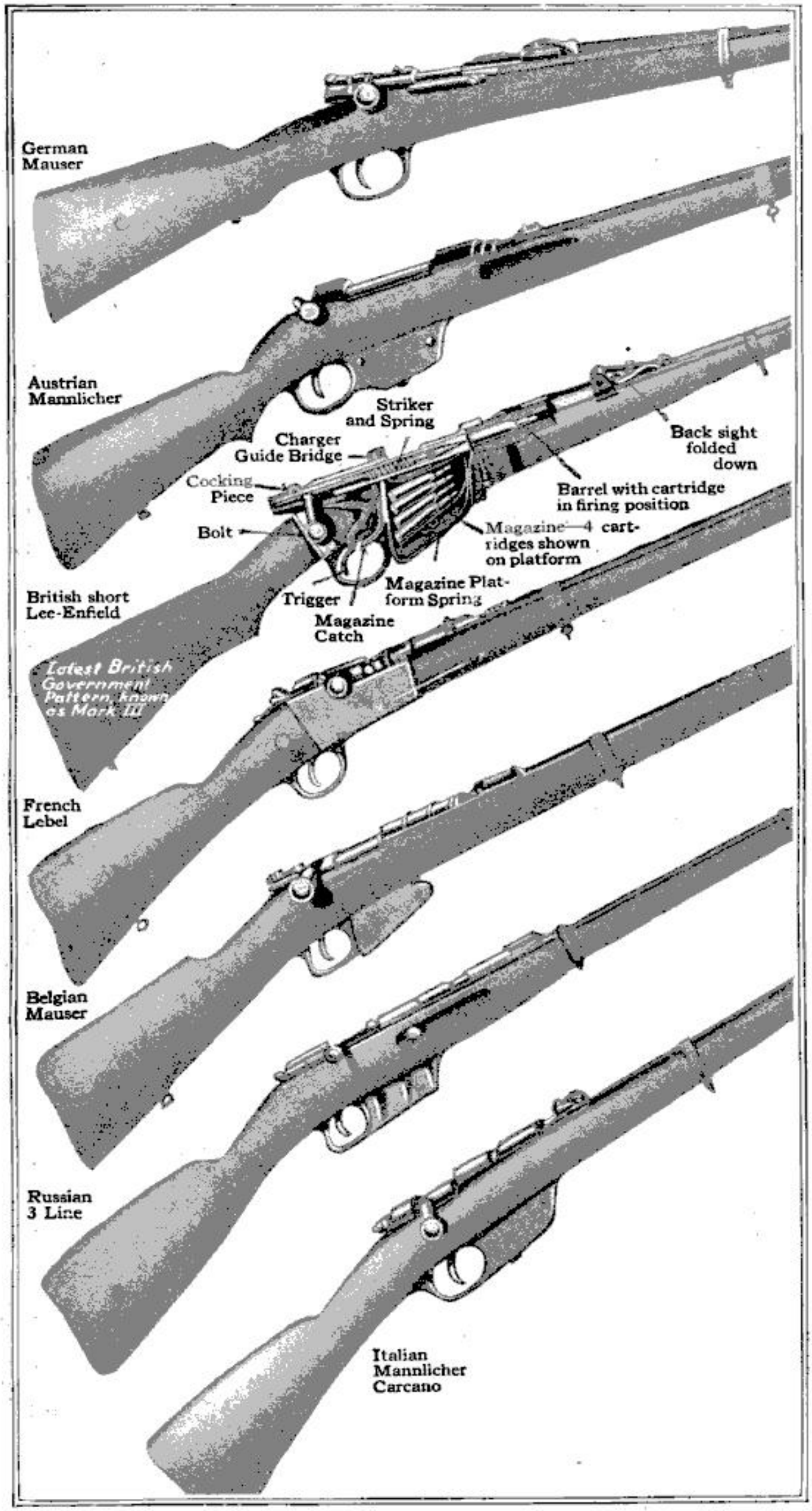


Photo by Brownell

A remarkable photograph of a brown thrasher feeding her young. The mother bird gathers the food, eats and digests it, and then disgorges it into the mouth, thrusting it far down the throat of the young bird, whose digestive apparatus has not reached a stage of perfect development

The Fighting Weapons of Seven Warring Powers



The German Mauser can fire faster than any other rifle used in the war. The magazine holds five cartridges, packed in chargers

The Austrian rifle is the lightest of all, yet its bullet, 244 grains, is the heaviest used by any of the powers. It is very rapid in action

The British rifle is the outcome of the South African War. It holds ten cartridges and is sighted from 200 to 2,800 yards

The French Lebel is the longest rifle. The tube magazine under the barrel holds eight cartridges. The bullet used in it weighs 198 grains

The Belgian Mauser of 1889 holds five cartridges carried in clips; it cannot be used as a single loader. It weighs over eight pounds

The Russian rifle is 7 in. longer than the British. It is capable of firing 24 bullets to the minute. The bayonet is always fixed

The Italian Mannlicher-Carcano is of the 1891 pattern. It is rather slow, discharging but fifteen rounds of shot a minute

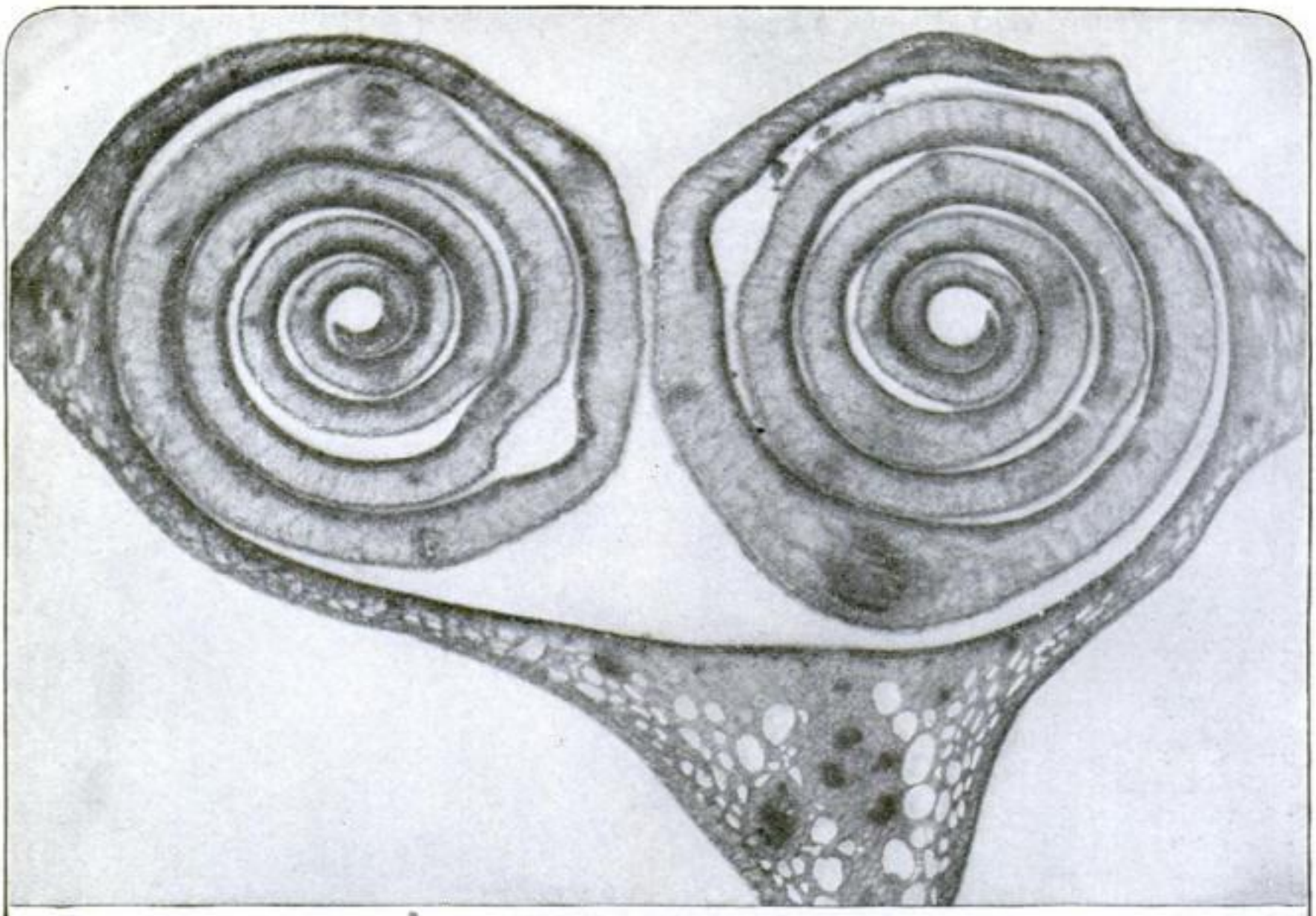
By Courtesy of the Sphere

Aeroplane Art of Today

Above: A Belgian aeroplane decorated with Brownies. This is done not so much for the edification of the enemy as for the personal pleasure that the Belgian airmen derive from it

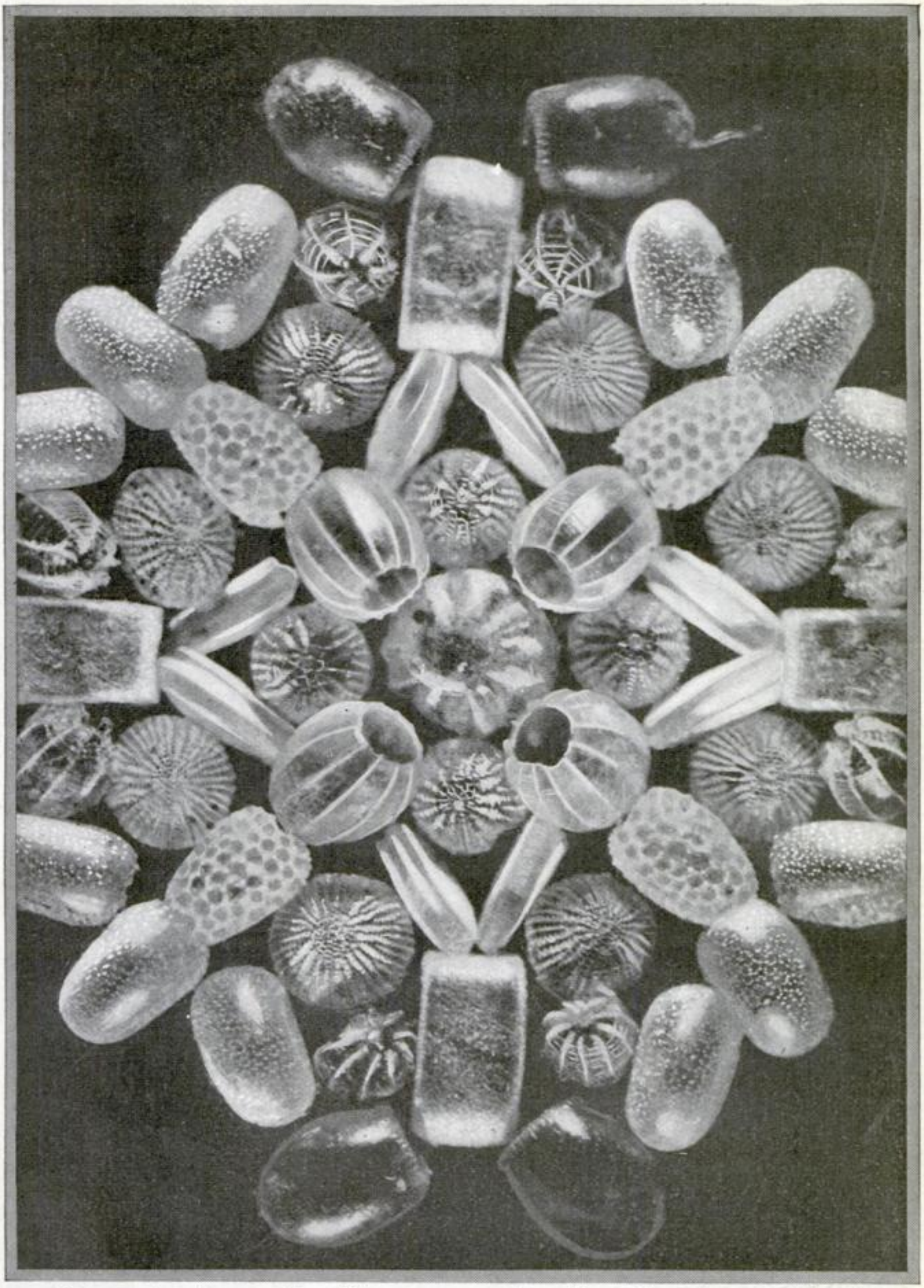
At right: A grim Medusa's head which acts as a mascot. To imagine this thing coming out of the sky straight at you is to court a week of nightmares. Perhaps this was the purpose of the artist in painting it

As a Packer Let Us Recommend Mother Nature



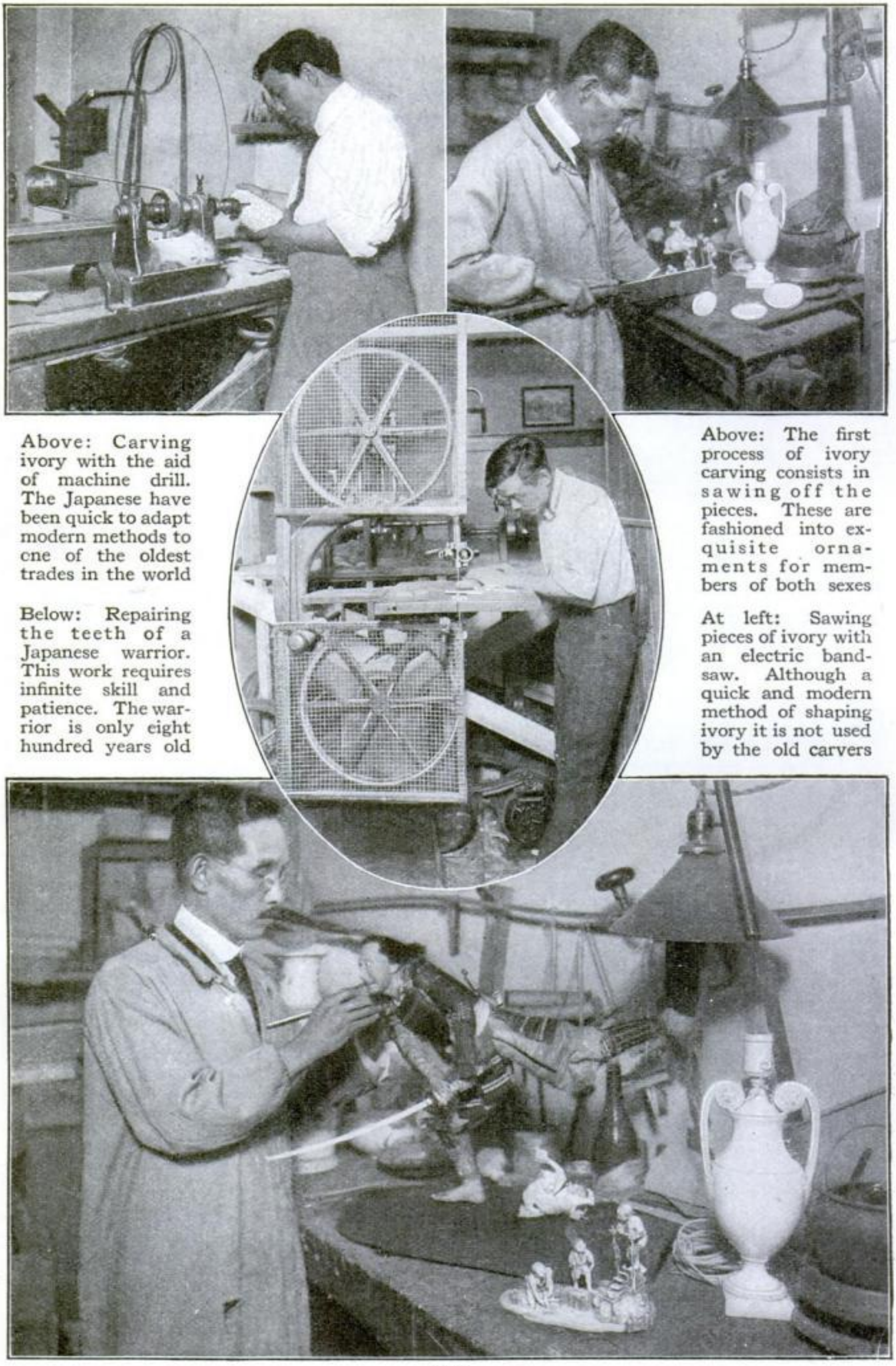
The yellow water-lily bud (above) is about twice the size of a pinhead. The bud of an ordinary sycamore maple (below) is twice the size of the water-lily bud; but the method of protection is entirely different for each. The edges of the undeveloped water-lily leaf are rolled toward the center, while the sycamore maple suggests a handful of squeezed lettuce

Not Candy but Moth and Butterfly Eggs



The marvelous forms and beautiful patterns of moth and butterfly eggs as revealed under the microscope. These artistic objects are obtained by covering the eggs with a bell glass before the larvae emerge. After the tiny larvae have crawled out, the fragile boxes are destroyed or mutilated by storms or winds. They retain their form better when occupied

Japanese Ivory Carvers Working With Modern Tools



Above: Carving ivory with the aid of machine drill. The Japanese have been quick to adapt modern methods to one of the oldest trades in the world

Below: Repairing the teeth of a Japanese warrior. This work requires infinite skill and patience. The warrior is only eight hundred years old

Above: The first process of ivory carving consists in sawing off the pieces. These are fashioned into exquisite ornaments for members of both sexes

At left: Sawing pieces of ivory with an electric band-saw. Although a quick and modern method of shaping ivory it is not used by the old carvers

A Danger Signal Used to Direct Attention to Overhead Perils

THE sign in the accompanying illustration has two uses. It consists of a heavy steel plate, enameled, with a red background and white letters, carrying its warning. When electrical machinery with high-pressure currents is being tested, this sign is placed near the apparatus and the words "High Voltage, DANGER" appear.

When the danger is overhead, as when overhead wires are being repaired or tested, or when a crane is moving loads which might spill or collapse, the sign is placed within the danger zone and a little sheet-metal flap, fixed to the top of the sign, is dropped down showing an arrow pointing upward. The arrow stands out vividly so that anyone passing would not fail to look up as directed, from curiosity if for no other reason, before proceeding. By reversing the small metal flap the sign may be made to display simply the one word "DANGER."

A heavy steel plate used to direct attention upward when the danger is from wires overhead

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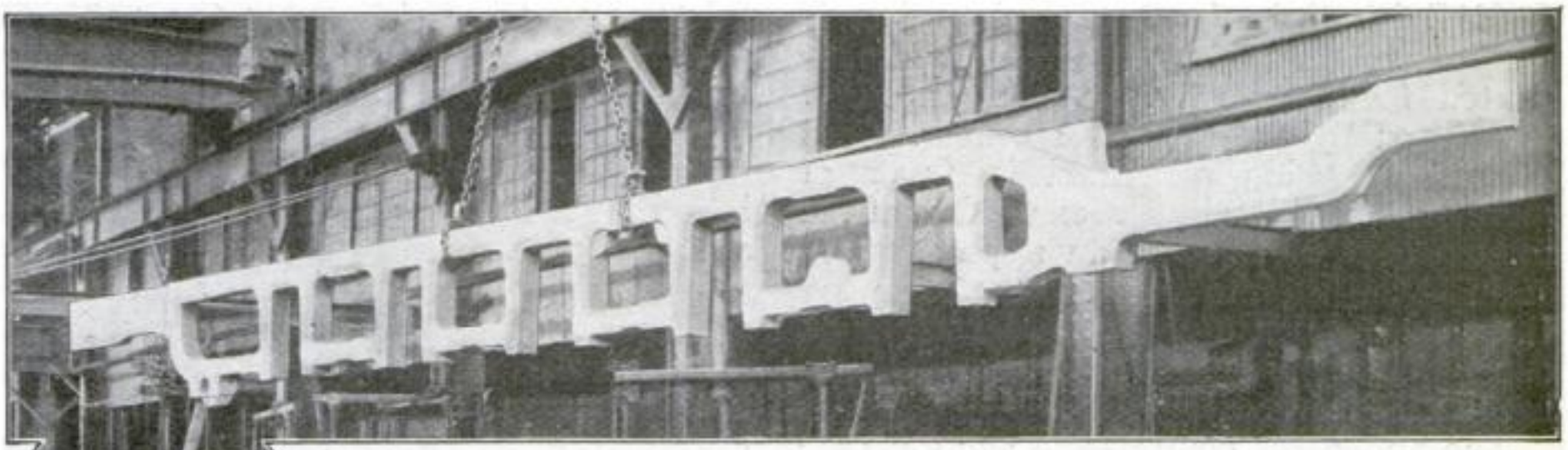
A Locomotive Side-Frame Which Weighs Nearly Seven Tons

ALL passenger and freight engines need in their construction what is known generally as a locomotive side-frame. On each side of the engine one of these is used; it assists in forming the main framework on which the superstructure is built.

Until about twenty-five years ago, side-frames were usually forged—a slow and difficult process. Now the cast-steel frame is used. This is made by pouring molten steel into a sand mold. This, after cooling, is removed from the surrounding sand of the mold, and, after cleaning, is carefully annealed in an annealing furnace to make the mass of steel homogeneous.

With the constant growth in the size of the modern locomotives the length and bulk of the locomotive-frame has also increased, until now frames are made that twenty years ago would have been considered impossible. When the one in the illustration was made it was the largest one recorded, measuring forty-one feet seven inches in length and weighing about thirteen thousand two hundred and fifty pounds. The metal is six inches thick. The five openings in the bottom of the frame are for the driving boxes into which the axle ends go which carry the driving wheels. There are five driving wheels on each side.

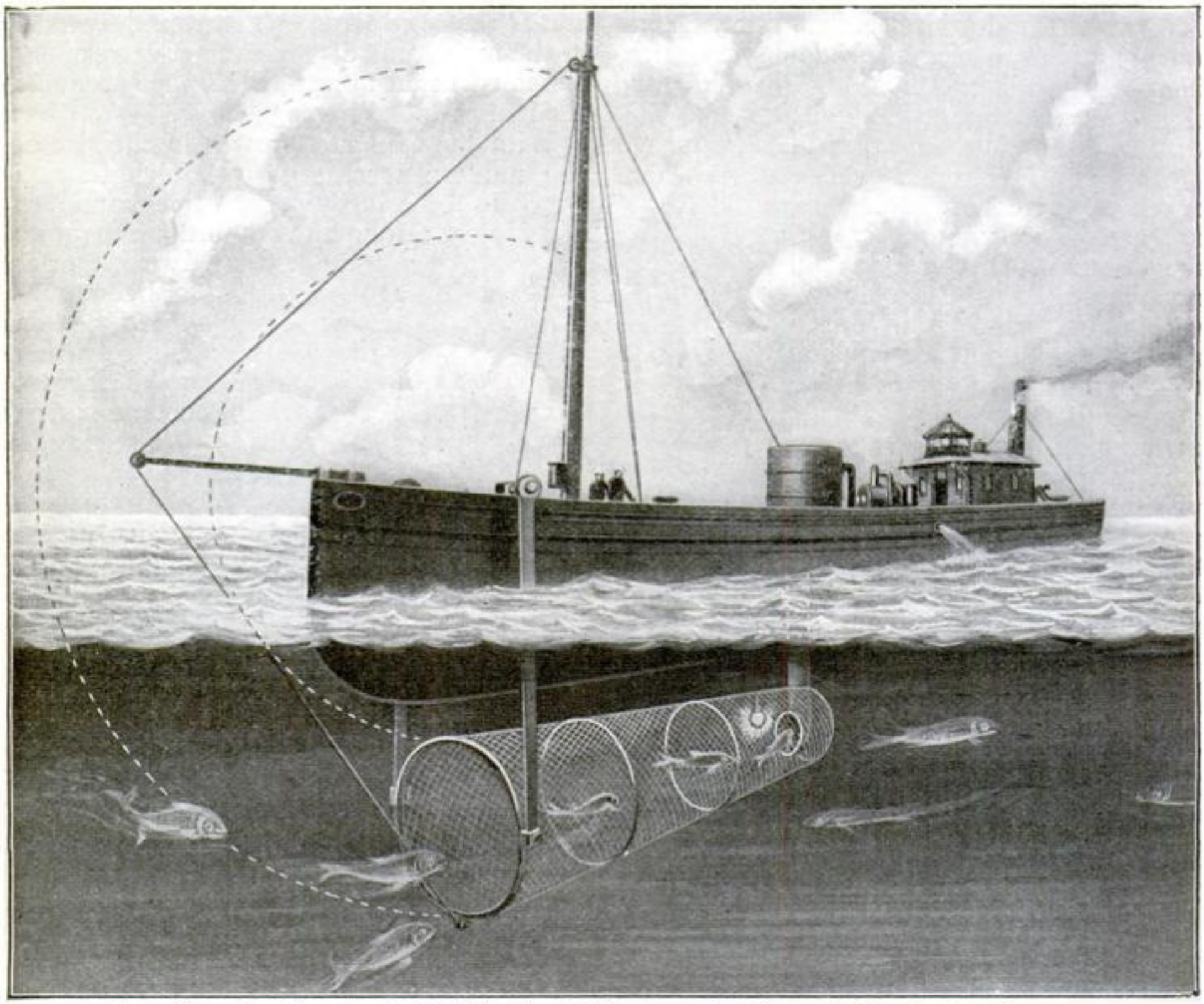
As steel cools it shrinks, so that about thirty-three per cent more steel is needed to pour a casting than is found in the final product. This extra metal is taken up mostly by sinkheads on the castings which act as fountains or feeders while the casting is cooling. These are cut off and remelted and used in making more steel.



This gigantic side-frame measures forty-one feet seven inches in length. The five openings in the bottom are for the driving wheels, five of which are provided for each side of the engine. It was molded in one piece by the new cast-steel process. The steel shrinks on cooling, so that thirty-three percent more molten steel, by volume, must be poured in the mold than appears in the finished product

Catching Fish by Suction

The vacuum cleaner principle applied to fishing on a wholesale scale



A suction pipe is connected with a funnel-shaped net and a centrifugal pump, by means of which the fish are drawn up and deposited in a container on board the boat

THE fish of the deep are getting wiser, if one can take the numerous devices invented for their capture as a criterion. Nets used by fishermen for centuries are apparently being discarded in favor of more recent fishing inventions. One of the most recent of these is an apparatus for enticing the fish into a net and then drawing them up through a pipe to a container on deck. C. P. Droz, of Nilversun, Holland, is the inventor.

The apparatus comprises a suction pipe connected with a centrifugal pump, a source of light such as an enclosed electric lamp placed in front of the suction opening, and a funnel-shaped net so arranged as to guide the fish to the suction opening. The fish, seeing the light, enter the net, approach the suction opening and are drawn through the pipe and delivered to a container on deck.

Steel hoops brace the net and strengthen it so that it retains its shape in spite of the action of the waves.

The net is secured at its rear end to the suction pipe and at its front end to a frame pivotally suspended from the boat, so that the net can be removed from the pipe and raised together with the frame to the position shown by the dotted lines in the drawing.

There is a recess made in the boat into which the pipe may be raised and stored away when it is not in use.

A Field Refrigerator for the Camper or Soldier

THE illustration shows a very ingenious method adopted by a company in the war zone for storing their food supplies, to keep them cool and out of the reach of the prowling dogs. A large hollow tree constitutes the refrigerator, which has been thoroughly cleaned of all rot. Shelves were set in and a hinged door of wire mesh fastened over the opening. In this case a steel door is used, but the camper can provide one of slats or poles that will serve his purpose as well.

Boy scouts will find the idea attractive. The refrigerator might be located in some favored spot in which an old tree covered with ivy would be available. This would effectually conceal the door from tramps or meddlesome marauders.

© Central News
To protect edibles from wild dogs which infest the district this food safe was constructed in the hollow of an old maple tree

A Caterpillar-Tread Cart for Conquering Bad Roads

CATERPILLAR wheels are generally associated with motor-driven apparatus of great weight, such as huge tractors, trench diggers, army motor-truck transports and, of recent exploitation, the "tanks" used by the British in their advance against the Germans in the Somme district. The accompanying photograph shows an adaptation of the caterpillar wheel—the caterpillar tread—attached to an English delivery cart.

Evidently the occupants of the caterpillar cart are agricultural people who live in an outlying district where intermittent rains and heavy traffic have played havoc with roads. By replacing the wagon wheels of the cart with the tread the worst roads can be traveled over with comparative ease. The principal drawback is that travel with the caterpillar tread is slow. On the other hand, the horse sinks just as deep in the mud as he always did. If the vehicle were motor-driven it would meet all requirements. The only other alternative is for some inventor to find an application of the caterpillar tread for horseshoes.

© Int. Film Serv.
A caterpillar tread attached to an English delivery cart enables it to go anywhere regardless of the condition of the roads

Shooting Soot From Stacks With Blasting Powder

WHEN powder-plant stacks accumulate enough soot to hinder the draft they can be cleaned by "shooting the stack" with a gun made for the purpose. This is nothing more than a wooden cannon, made of a piece of shafting fourteen inches long. One hole is bored into the center of the piece and a horizontal hole is bored through the piece to the bottom of the center bore. This completes the cannon.

Blasting powder is placed in the mouth of the cannon to about two inches from the top. This is tamped to the collar with dry clay, and a short fuse is inserted in the touch-hole. The cannon is placed at the bottom of the flue and the fuse is lit.

The engineer's wind shield is fixed to the window-frame of the cab. High speed does not affect its operation

A Wind-Deflecting Lookout Mask for Engineers

A STEEL mask for railroad engineers which secures for them a clear vision ahead, that cannot be obscured by the snow, rain or sleet, is being tried out on engines of the Canadian Pacific Railroad. The mask, which is attached to the window-frame of the cab, contains no glass, its principle being based on the deflection of wind currents by flanges.

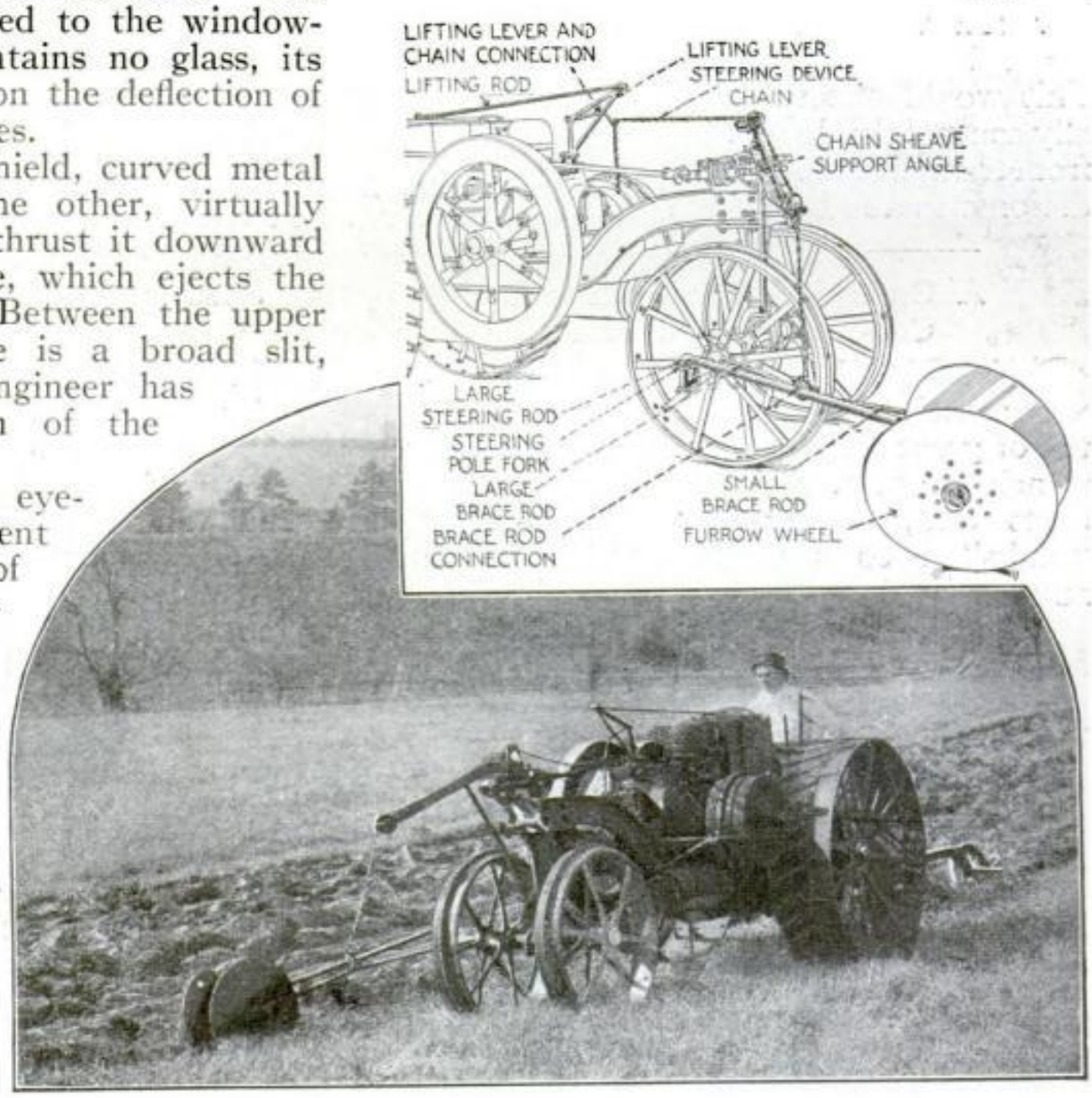
At the top of the shield, curved metal plates, one behind the other, virtually scoop in the air and thrust it downward into a short air-chute, which ejects the draft automatically. Between the upper plates and the chute is a broad slit, through which the engineer has an unobscured vision of the roadway.

It is said that this eye-protector is so efficient that a light fall of snow—which is considered to be the most trying of conditions—will have no effect upon it. Another experiment, which attested to its efficiency, was made by lighting a match behind the gap. The flame was drawn forward. The speed at which the train is traveling does not affect the operation of the shield.

An Adjustable Steering Device for the Farmer's Tractor

NOW comes the self-steered light farm-tractor, so built that the operator can give more attention to his plows and that any irregularities in the furrows are compensated for. Two disks, mounted on a rod attached to the axle of the front wheels, are set so that their rims or edges are closer together at the front than at the rear. The outer disk is larger and is set lower than the inner one, so that, when placed in a furrow, it pushes the inner one against the land-side of the furrow. The tractor-wheels are prevented from swerving by the pressure of the inner disk against the land-side of the furrow.

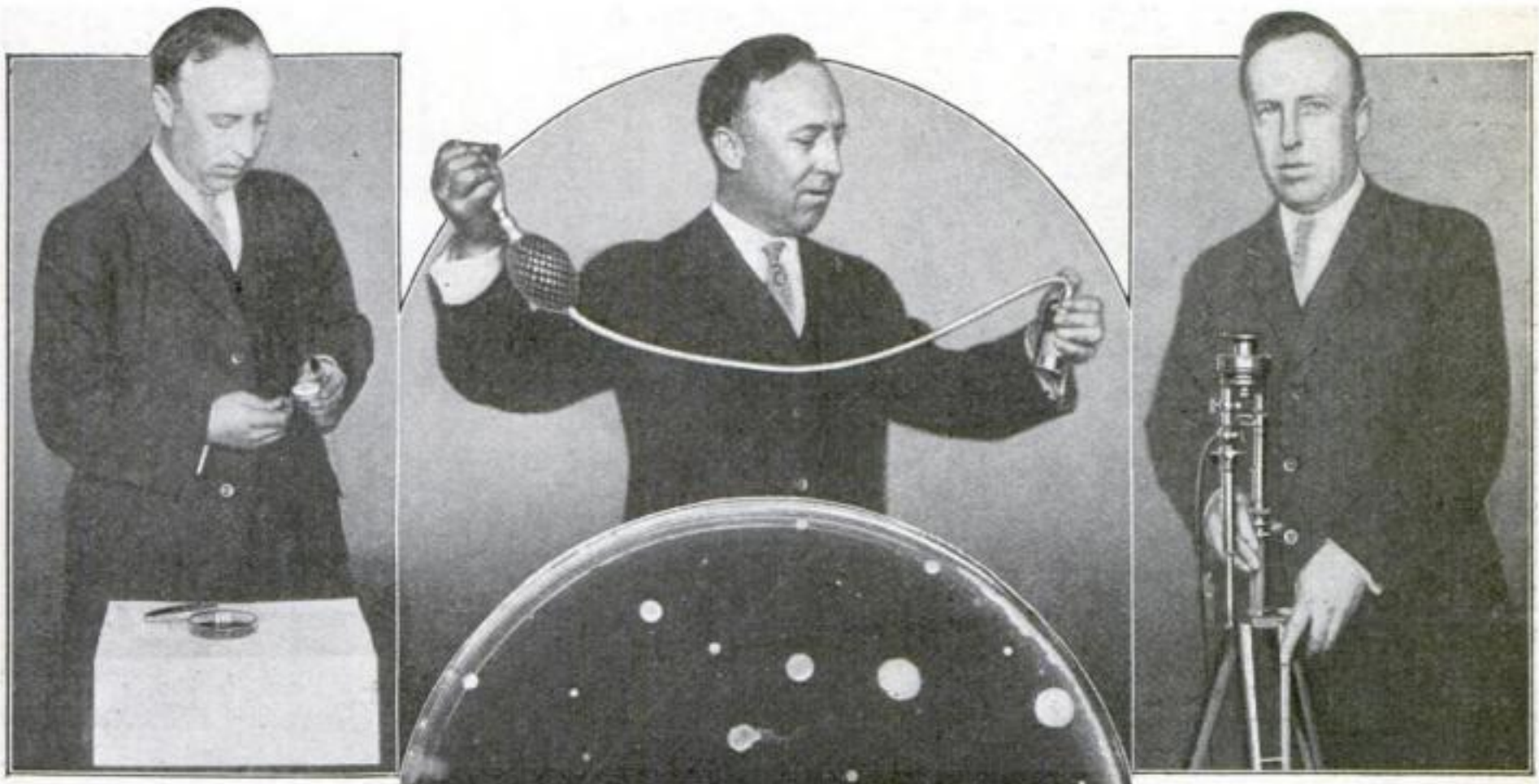
The disks are mounted on a rod supported by chains, pulleys and a lever, which raise them from the ground for turning corners or for moving the tractor from the field.



The device is adjustable so that the tractor will run almost any desired distance from the furrow

Making Air Fit to Breathe

Experimenters are washing it and filtering it in order to free it from dust and bacteria



To test air for bacteria a film of gelatine is exposed for three minutes. It is then placed in an incubator for two days at the temperature of the room

In center above: The rate at which fresh air is supplied to each person is obtained by filling bottles with air and analyzing it for carbon dioxide

No more than fifty thousand particles per cubic inch should be present under the microscope, although some samples have shown twenty million

At left: a gelatine plate after two days of incubation. No more than twelve large colonies of bacteria should result from the air in any room

IT is only recently that health commissions have studied all the conditions that have to be considered in mechanically counteracting drowsiness and the sore throats we get from being shut up all day in our offices, factories, or schools.

Already many important and interesting facts have been brought to light. One of the discoveries which will change the beliefs of many of us is that the carbon dioxide exhaled in our breath is practically harmless; it is only when it amounts to quantities eight to ten times the quantity found in the best air that we begin to be uncomfortable. Nowadays, an engineer will analyze the air of a room for its percentage of carbon dioxide only because this percentage furnishes the best and quickest indication of the number of cubic feet of fresh air which is required for each person.

Important work has been accomplished by the Chicago Commission on Ventilation in determining the exact effects of the humidity, or moisture, of the air upon comfort. They have found that a cold room can be made as agreeable as one that is warm, simply by increasing its humidity.

Dust in the air of a room also lowers the vitality of the people in it, when it is present in 3,000,000 or more particles per cubic inch.

We now understand why the previous systems of ventilation—of which some are still in use—were not satisfactory. In these systems only the supply of air and its temperature were regulated. They lacked the means to moisten and dry the air and to cleanse it sufficiently of dust.

This Destructive, Gnawing Fire, in a Mammoth Grain Elevator

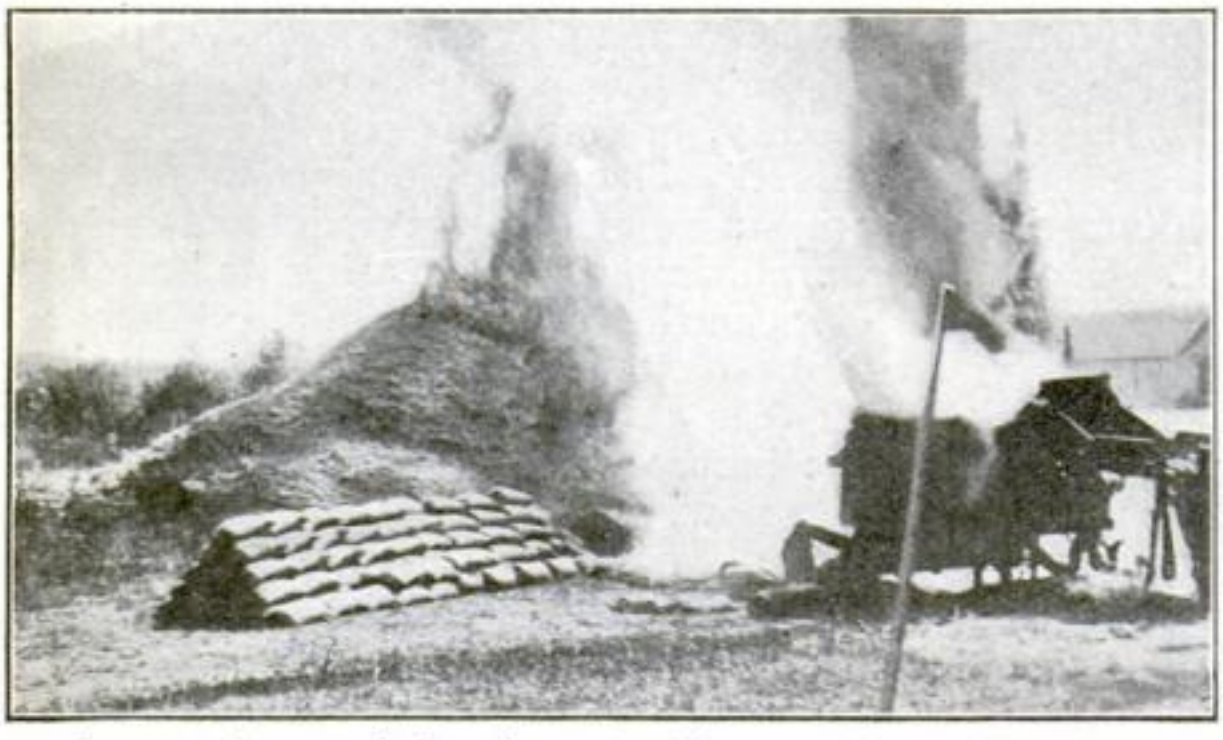
When the big grain elevator at St. Bernard, Ohio, caught fire, it was a year later before the flames were finally quenched. The fire worked its way to the very bottom of the grain bins. Water seemed

Preventing Dust Explosions and Fires in Grain-Separators

UNUSUAL interest has been awakened in the Pacific Northwest during the last two seasons by the large number of fires and explosions in grain-separators. These fires and explosions were most frequent in the wheat-growing territory in eastern Washington and northern Idaho. Similar explosions have occurred in scattered localities throughout the territory lying west of the Mississippi River.

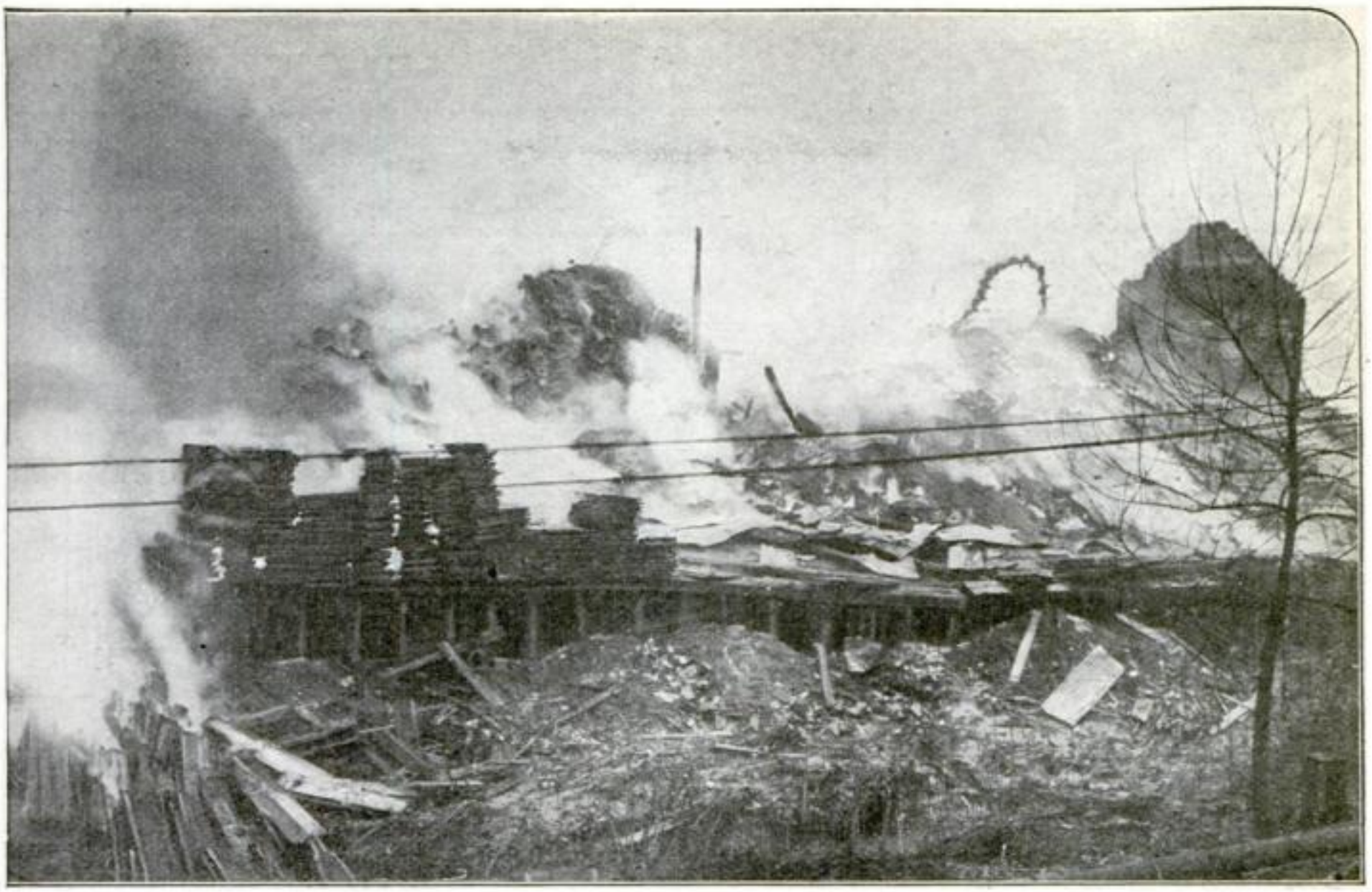
For some time the Department of Agriculture has been studying dust explosions in grain mills, elevators, and similar plants. The close relation of thresher explosions to the general study of grain-dust explosions led to the inauguration of a special investigation of this allied problem in the northwestern field during the 1915 season. As a result of this study one hundred and sixty-six fires were investigated and reported.

The investigation indicated that the wheat crop contained a large percentage of smut (a form of very fine, dry dust) and that the explosions and fires in many cases were due to the formation of an explosive mixture of smut-dust and air and the ignition of this mixture by static electricity during the threshing operations. In almost all cases the flame from the explosion and fire was blown into the straw pile, and in many instances spread to the stacked grain and also to the unthreshed grain in the field. As a result several hundred acres of



A smut-dust explosion in a threshing machine. The photograph was taken at the instant of the explosion and fire

in Ohio, Burned For More Than Twelve Months



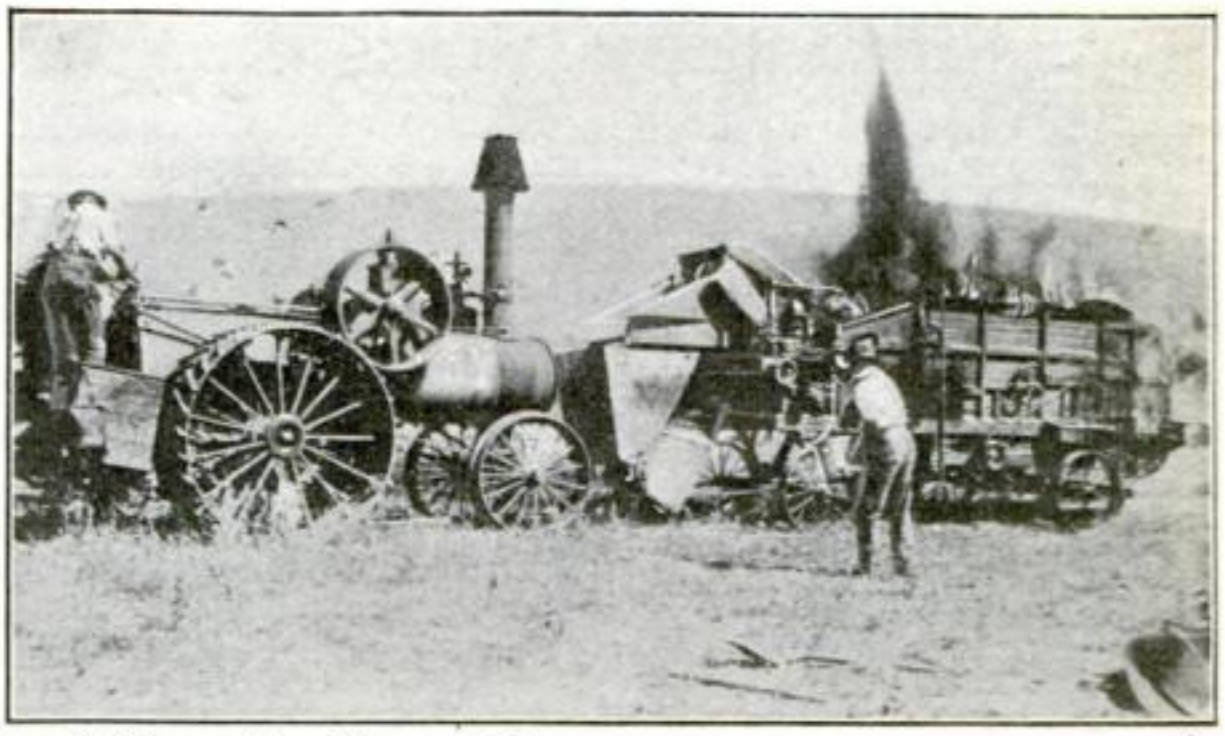
only to add to the intensity of the heat. It was estimated that a million gallons of water were poured on the fire without subduing it. The smut-dust theory is advanced as the cause of it

grain were destroyed. The grain loss due to the fires investigated reached about $50,000.

The experimental work carried on during the investigations proved conclusively that, under favorable atmospheric conditions, static electricity is present on all types of machines. It appears that the largest discharges of static electricity were obtained from the steel machines.

The fires and explosions occurred, as a rule, when fall wheat was being threshed, and very rarely occurred during the threshing of spring wheat. The discharge from the machines, while smutty wheat was being threshed, was more noticeable than when clean wheat was going through the process. Fall wheat, as a rule, contained much more smut than spring wheat. The theory was advanced that the small particles of smut easily became electrified when the kernels were broken up by the cylinder teeth and that each particle became charged with static electricity.

From a study of conditions, several methods have been developed for preventing explosions and fires. The investigators believe that a system of electrical connection between all of the moving parts and a common wire, and a thorough grounding of this common wire, will prevent a large percentage of the fires that are due to the presence of static electricity and an explosive mixture of smut-dust and air. Several methods of wiring are recommended, the system varying with the type of machine.



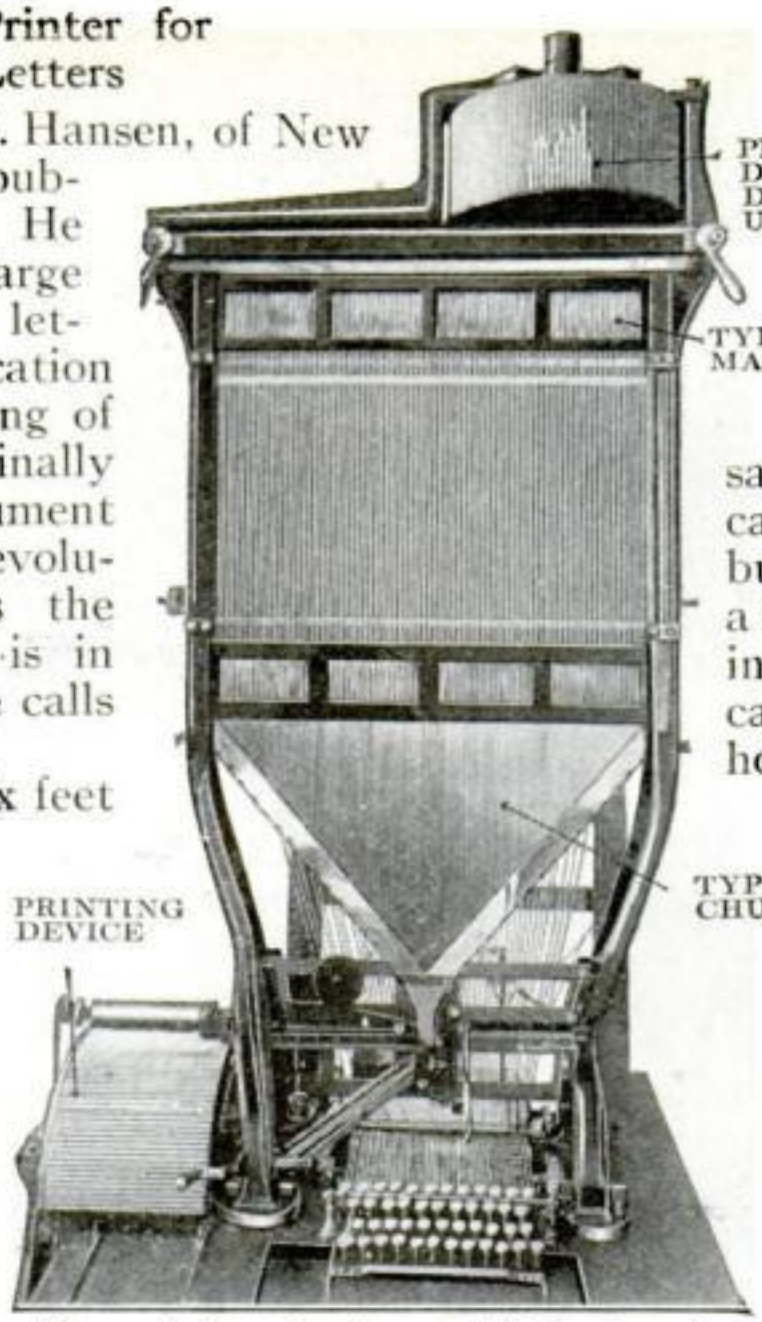
Pulling a threshing machine away from a straw-stack after an explosion and fire, to avoid a greater conflagration

A Mechanical Printer for Fac-Simile Letters

SOME years ago H. P. Hansen, of New York city, was the publisher of a newspaper. He had occasion to mail large quantities of fac-simile letters advertising his publication but he found the printing of the letters expensive. Finally he invented an instrument that appears to be as revolutionary in its line as the Mergenthaler Linotype is in the newspaper field. He calls his creation Autotype.

It is a machine about six feet in height, provided with a magazine that contains the type, which is released by means of a universal keyboard. There is a great advantage in this, since the office stenographer can compose the type without any previous experience. The composed type is transferred directly to a printing device by an operation that resembles the movement of a typewriter-carriage. When the matter to be printed has been composed and transferred to the printing device, the printing is done directly from that mechanism.

When the process of printing is over, that part of the device which holds the type and resembles a portable segment is removed and placed on top of the machine. The slots in the printing device correspond with those in the distributing mechanism so that the types slide by gravity from the former down into the latter. The distributing mechanism is operated by means of a one-tenth horsepower electric motor. The current is taken from a lamp socket.

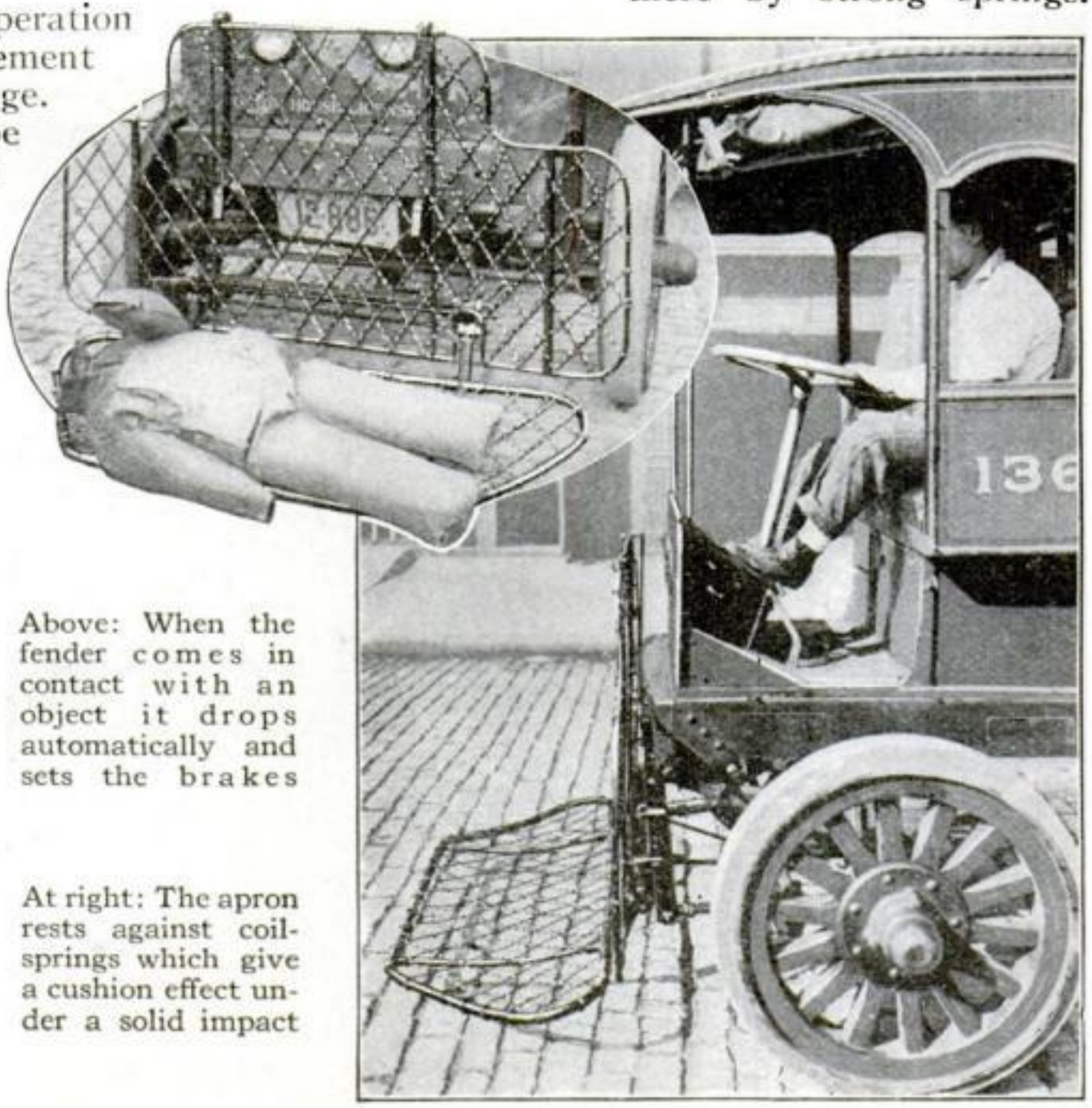


The printing device at left is placed on top of the machine for distributing

An Automatic Safety Fender Which Sets the Brakes

THE Public Safety Commission of New York has approved a new safety fender for use on street cars, motor-trucks and motor-buses. The fender consists of a life-guard hanging vertically in front of the bumper of the car, and an apron extending horizontally at any required height above the pavement, and projecting twenty-six inches in front of the bumper.

The apron is set and held in normal position by means of a simple trigger device that securely locks it. When the trigger is released the apron is instantly thrown downward and backward to the pavement and is held there by strong springs.



Above: When the fender comes in contact with an object it drops automatically and sets the brakes

At right: The apron rests against coil-springs which give a cushion effect under a solid impact

The Flying Mail-Carrier

An aeroplane to carry mail on the Buzzard's Bay route seems to the Postmaster General to be the solution of a special problem

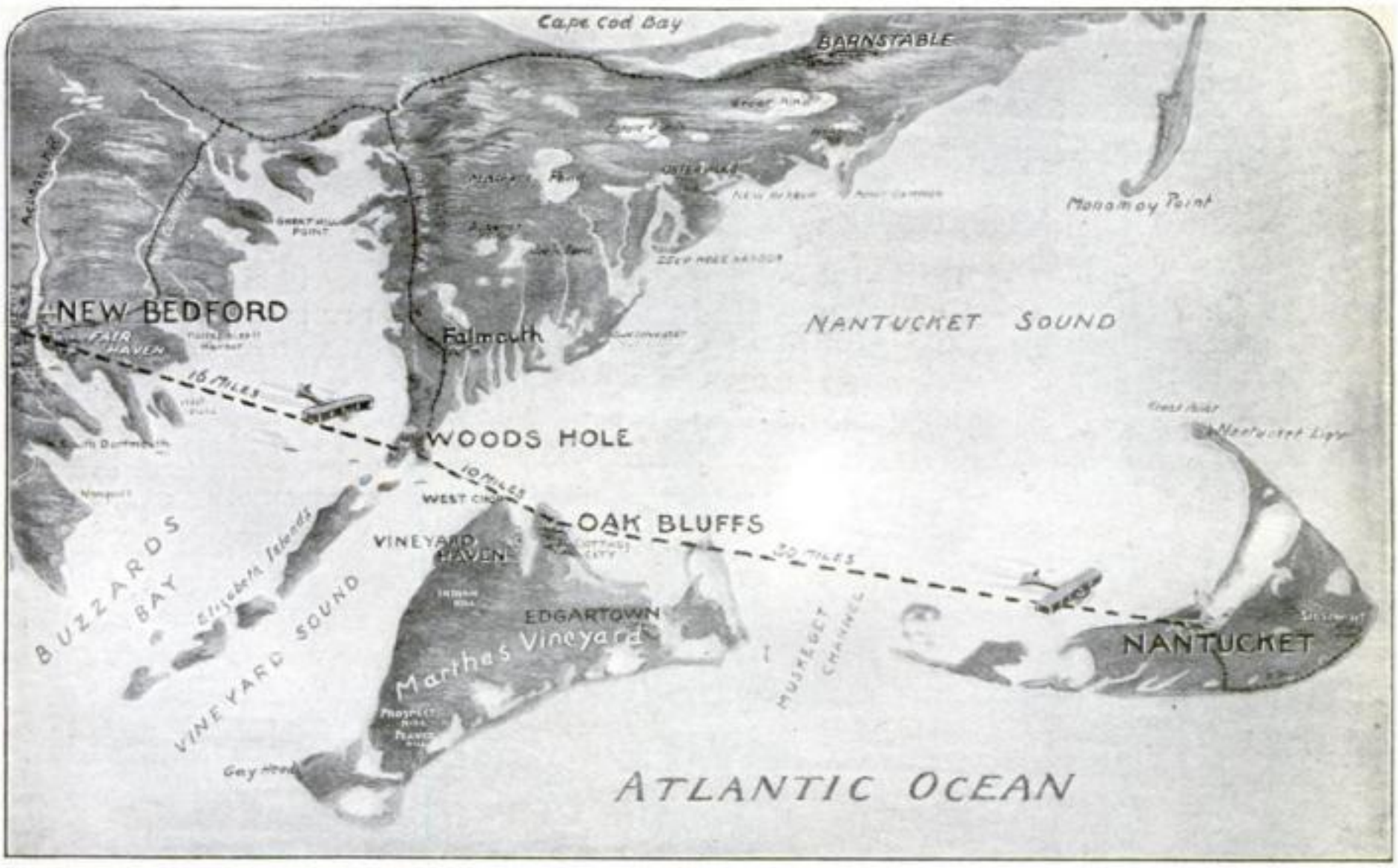
THE science of aviation has so far progressed in recent years that now, in the opinion of the Postmaster General and postal authorities, it offers a practical means of carrying mail. To this end bids have been opened for aeroplane service on seven mail routes in Alaska and one in Massachusetts. These routes were chosen because the need of good facilities for mail communication is imperative and because the difficulties of other means of transportation are serious.

The Massachusetts route is across Buzzard's Bay and Nantucket Sound. Most of the route lies over water, and the wind velocities average high during the Fall and Winter. At times fog is prevalent. However, if the exacting weather conditions and weight requirements of the route can be met by aerial carriers, it presents an excellent opportunity for improved mail service.

Two hours is allowed for the flight from New Bedford to Nantucket, with stops at Woods Hole and Oak Bluffs. It is assumed that in actual service the flying mail-carriers could keep this schedule and have nearly an hour to spare. It is a question whether aeroplanes or hydroplanes, which could start and land upon the water, would be more serviceable.

If adopted, the aeroplane service would reach the population of the islands of Martha's Vineyard and Nantucket. It would supersede service now performed by steamboat. In summer these islands have a large population, which makes the volume of mail nearly double that of the winter. The first or morning trip in summer necessitates carrying not less than three thousand pounds of mail.

At the starting point, New Bedford, the mail-carrying fliers could start about two and one half miles from the postoffice. At Woods Hole, Oak Bluffs and Nantucket satisfactory landing places could be secured one half mile from the center of town. The distance traveled by aeroplane over the route mapped out would be fifty-six miles.



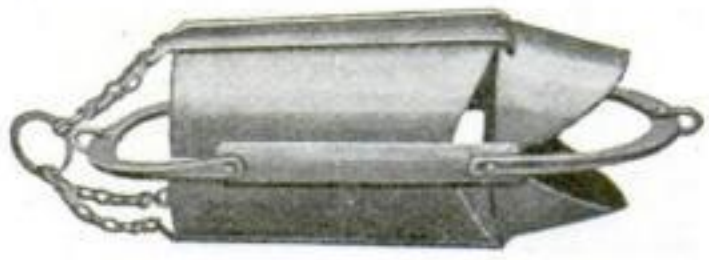
It is fifty-six miles from New Bedford to Nantucket. The Post Office Department allows two hours for the flight by aeroplane, although one hour is said to be sufficient in favorable weather

Cleaning Sewers from the Street

Many of the disagreeable features of the work are being eliminated

A NOVEL machine which is designed to clean sewers from the street and thus eliminate much of the disagreeable work in the sewer, has been put on the market by a western manufacturer. The apparatus and its method of operation are shown in the accompanying illustrations.

The device consists of two four-wheeled trucks placed at two successive manhole openings and a special steel bucket pulled between manholes by means of a cable, one end of which is attached to a hand-winch on one truck and the other end to a similar winch on the other. The bucket is not necessarily drawn from one manhole to the next, but is drawn into the sewer only far enough to be filled with the deposit and then pulled out of the same manhole in which it was inserted.



The expansion bucket, which is used with a trolley-jack. The jaws are sharpened for scraping

This is made possible by the construction of the bucket, which has two hinged scoops at one end so arranged as to close up tight when the reverse pull is made, and also to expand the bucket when it is emptied. Four guard-plates are riveted to the sides of the bucket to prevent excessive wear. They form a hinge for the jaws. The edges of the scoops are sharpened to cut any roots or growths that might be in the sewer bottom.

A special feature of the apparatus is the means whereby the full bucket is lifted out of the manhole without the cable's cutting into the sewer or manhole brickwork. This is done by means of a guide-jack, consisting of a yoke with ball-joint adjusting-screws at one end and a wedge connection on the other end. This is lowered into the manhole on chains hooked to the manhole-rim, and carries a pivoted arm with a cable pulley. When the bucket is being taken out, it strikes the arm, revolving it upward about its pivot, so that the bucket is guided free out of the sewer-tile and then up the center of the manhole without obstruction.

The sharpened jaws scrape the tile thoroughly so that every particle of debris is removed. When shut they are so tight that nothing in the bucket can escape.

When the reverse pull is made on the cable the jaws of the bucket close automatically so that nothing can escape except the excess water, for

What Happens in the Stokehold of the Speeding Destroyer

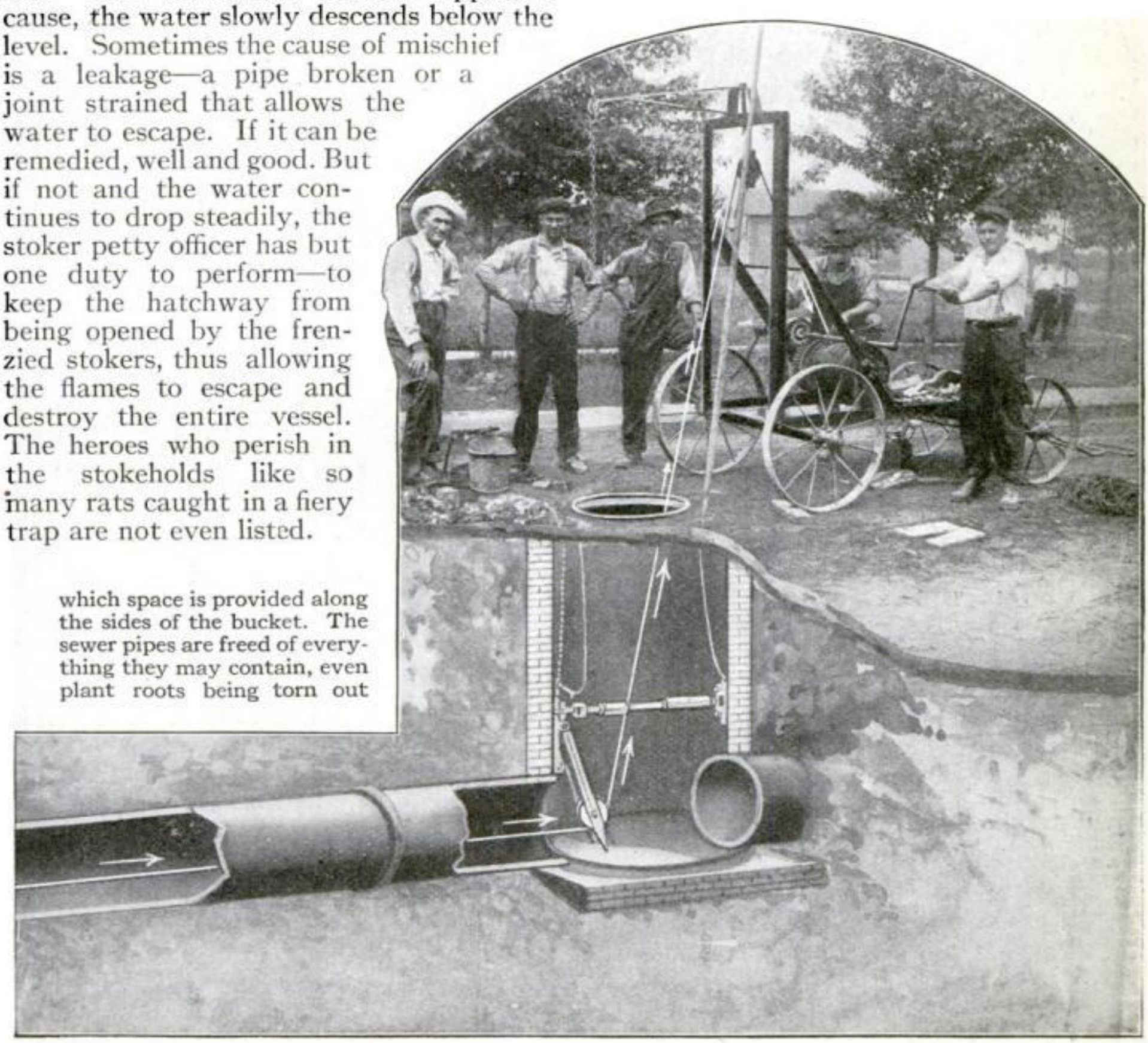
THE soldiers who fight with least recognition in the battles at sea are the stokers of the destroyers running at full speed. Eight men work under the command of a stoker petty officer, in a space so narrow that movement of any kind seems impossible. There is a furnace in front and one in the back. Sandwiched in between is a maze of levers, pipes, pumps and gear. Yet within these close quarters the stokers find space to perform their heart-breaking toil in an atmosphere almost too hot to breathe. When the men are at their posts, the iron hatch is closed down and the air sucked in through a ventilator has to pass through the furnace before it gets to them.

So long as the pumps work well and the evaporated water is displaced with automatic regularity by fresh, neither the tubes nor the boiler casing can get dangerously hot. But sometimes without apparent cause, the water slowly descends below the level. Sometimes the cause of mischief is a leakage—a pipe broken or a joint strained that allows the water to escape. If it can be remedied, well and good. But if not and the water continues to drop steadily, the stoker petty officer has but one duty to perform—to keep the hatchway from being opened by the frenzied stokers, thus allowing the flames to escape and destroy the entire vessel. The heroes who perish in the stokeholds like so many rats caught in a fiery trap are not even listed.

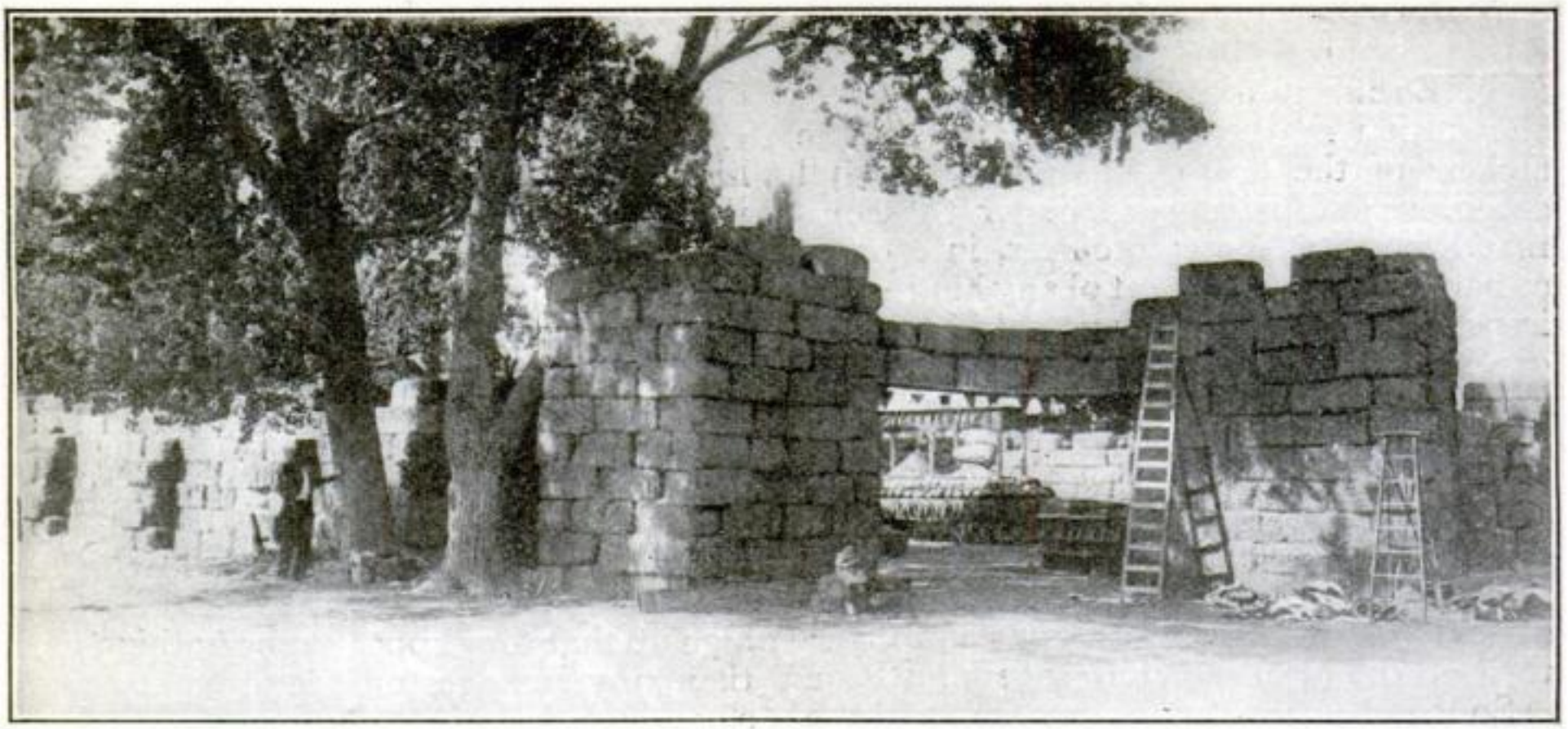
The Sentinels of the Sky Above the War-Zone Trenches

SENTRIES and sentinels have always held a prominent place in pictures and histories of war-times; but it remained for the present war to develop the sentinels of the sky. These are lines of balloons, each balloon about a rifle-shot from the next, and moored about two or three miles behind the front line of trenches, forming a dotted line in the sky which runs roughly parallel with the real front of the battle.

With unwinking vigilance the sentinels in these balloons scan the sky above and around them and the earth beneath them through powerful glasses. Although so high up that they appear to be nothing more than tiny smudges on the grayness of the sky, they can pick out so small an object as a suspicious-looking automobile dashing along through a fog, and will signal the artillery in time to stop its progress.



which space is provided along the sides of the bucket. The sewer pipes are freed of everything they may contain, even plant roots being torn out



A palace of alfalfa was the attraction at a harvest festival held at Bishop, California. Cows and horses later consumed it, and enjoyed it as much as had the residents of the community

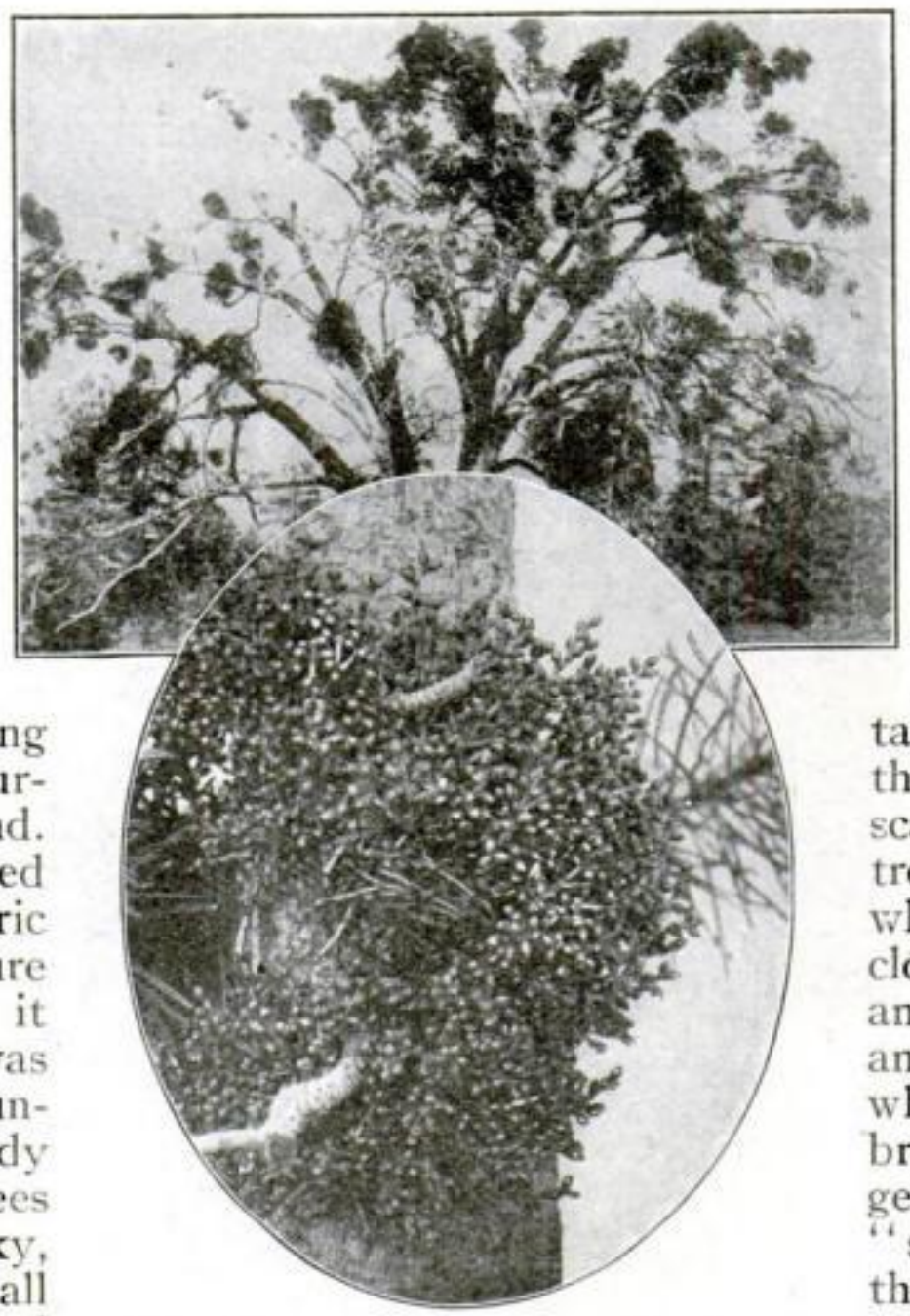
A Palace Which Was Eaten by Horses and Cows

AT a recent Harvest Festival held at Bishop, Cal., the principal attraction was a great palace built of alfalfa. The city of Bishop is located in a hay-growing center, so there was ample material with which to rear the unique structure. Baled alfalfa—more than one thousand tons of it—was used, and a number of men were employed for several weeks on the job.

The palace was designed to be an exhibit hall. It was ninety feet wide and one hundred and seventy feet long, beautifully proportioned, with an imposing entrance and walls turreted all the way around. At night it was outlined with hundreds of electric lights, making a picture more charming than it presented by day. It was built around and under towering Lombardy poplars and other trees and was open to the sky, but so arranged that all exhibits which required shade were protected.

Mistletoe: A Christmas Decoration and a Forest Pest

MISTLETOE, to which so much sentiment has been attached as a Yuletide decoration, has become such a destructive pest in this country that the Government scientists recommend its extermination.



Two trees dying of starvation but covered with a wealth of mistletoe

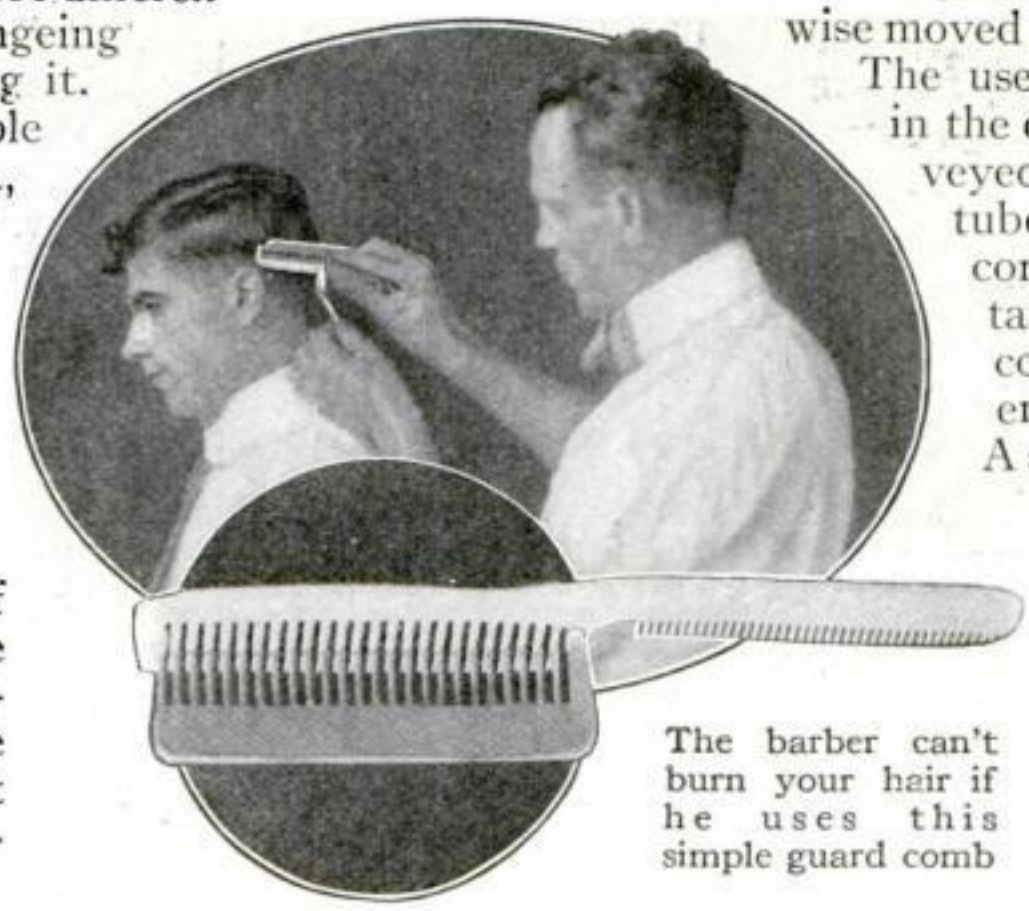
It is a leafy, green shrub commonly found growing upon various species of broad-leafed trees throughout the country, and showing a specially strong sentimental attachment for the oak.

It fastens itself upon the tree—penetrates its tissues, and draws nourishment from it, deforming it and sapping its vitality. Birds feed upon the mistletoe berries and scatter the seeds from tree to tree. The pod in which the seed is enclosed is sticky and pulpy and readily adheres to any part of the tree upon which it falls, whether branch or trunk. When germinating, a spike-like "sinker root" bores through the bark until it reaches the sap, of which it robs the tree.

A Singeing Comb Which Prevents Hair Conflagrations

SOME barbers do not differentiate between singeing your hair and burning it. To eliminate all possible danger David P. Cera, of Iron Belt, Wisconsin, has devised a hair-singeing comb which holds the hair in such a position that only the projecting ends are affected.

The teeth of the guard-comb stand off or are spaced from the teeth of the singeing-comb, so that only the ends that project through the guard-comb are singed.



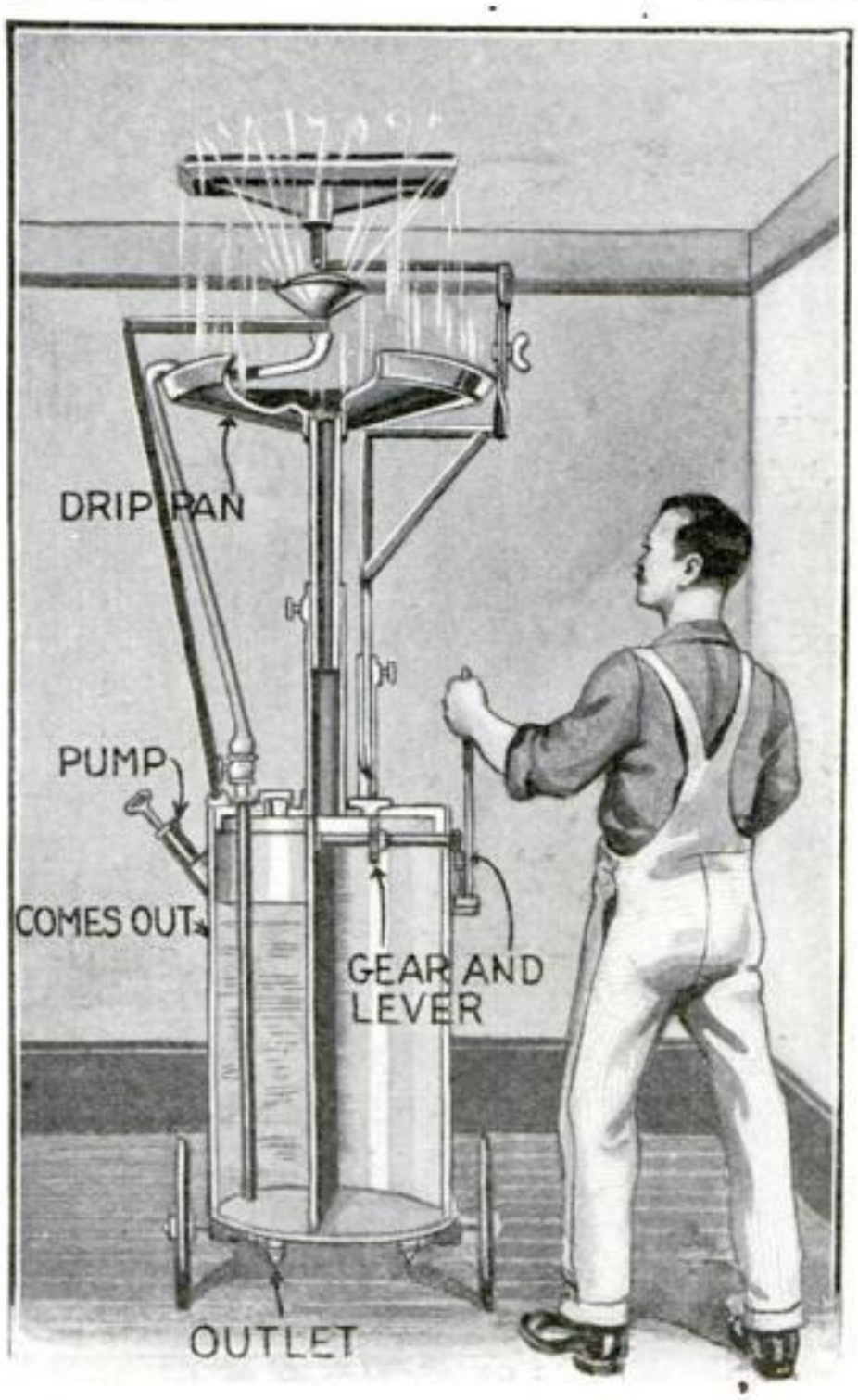
The barber can't burn your hair if he uses this simple guard comb

A Machine for Cleaning Ceilings in Large Buildings

SIMON GOTTLIEB of New York must know something of the neck-craning difficulties of cleaning a ceiling. We judge so because he has invented a portable contrivance comprising a tank on wheels with a superstructure consisting of a movable or rotatable brush on an adjustable arm; a spray, also on an adjustable frame; and a centrally placed drip-pan to catch all spray and drops of cleansing fluid falling back from the spray funnel or ceiling.

The tank is subdivided to contain both the cleansing fluid (in the shaded section) and the dirty water conveyed from the drip-pan.

When air-pressure is applied through a pump, the cleansing fluid is forced through a tube out of the spray to the ceiling surface. A brush is then rotated or otherwise moved by gear and lever. The used fluid is caught in the drip-pan and conveyed by the central tube to the secondary compartment of the tank. Both tank compartments are emptied by cocks. A small motor might conceivably be used to actuate the brush, and the labor of cleaning ceilings in large buildings could thus be minimized.

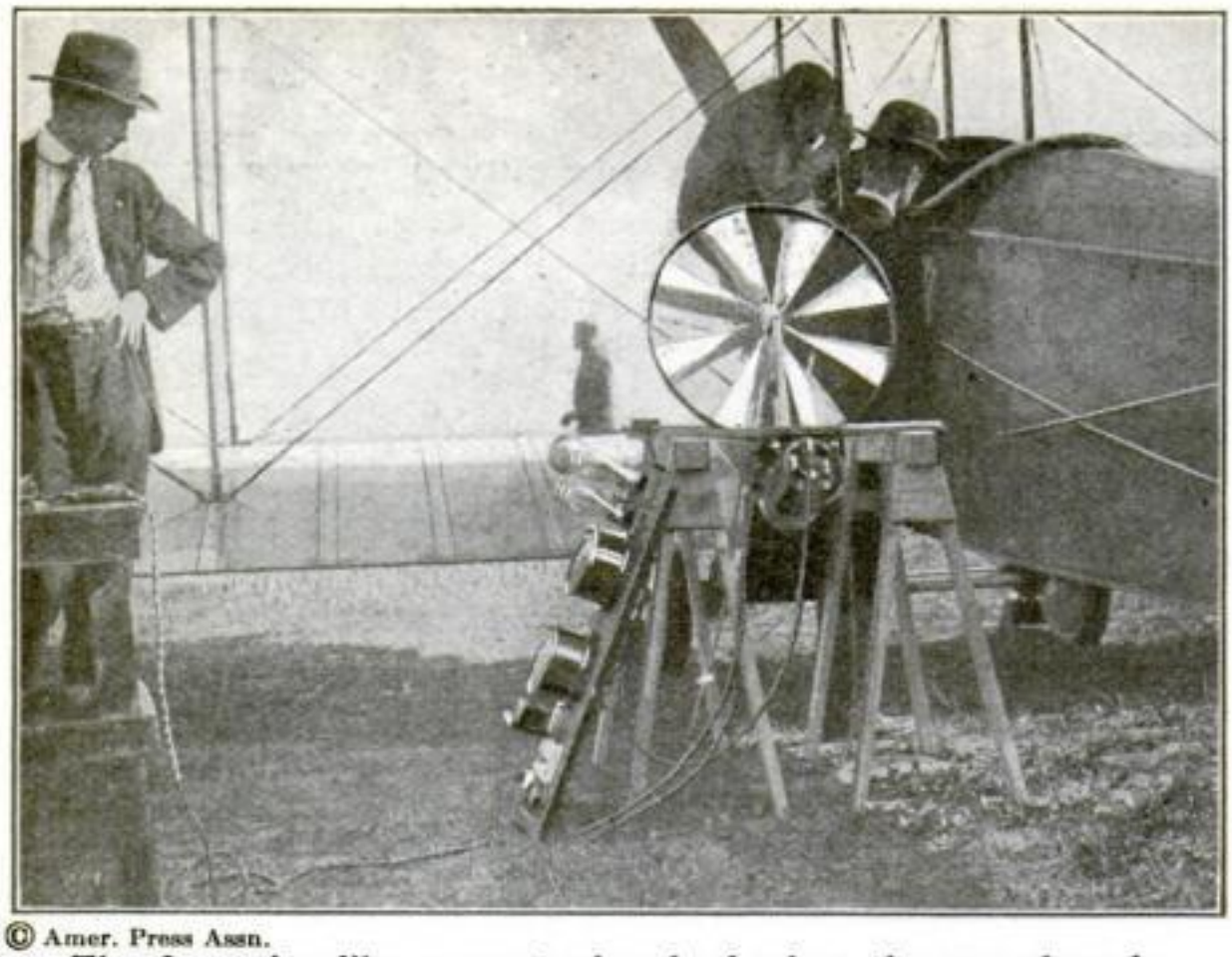


Water is forced against the ceiling surface and a rotating brush moved by a gear and lever cleans it

Utilizing the Waste from Welsbach Mantles

IN making Welsbach mantles most of the raw material is wasted. About fifty per cent. of that is cerium. You light your cigar with that cerium, probably. Combined with alcohol, it produces alcohol-igniting sparks when scratched. If a Welsbach has brains enough to device a mantle, depend upon it he has brains enough to devise a spark-producing alloy out of the waste left in the manufacturing process of the mantle.

If you wonder what makes the flame of certain electric arcs so white, attribute it to cerium. The waste of the Welsbach mantle industry actually serves to stimulate a rival of the Welsbach mantle itself.



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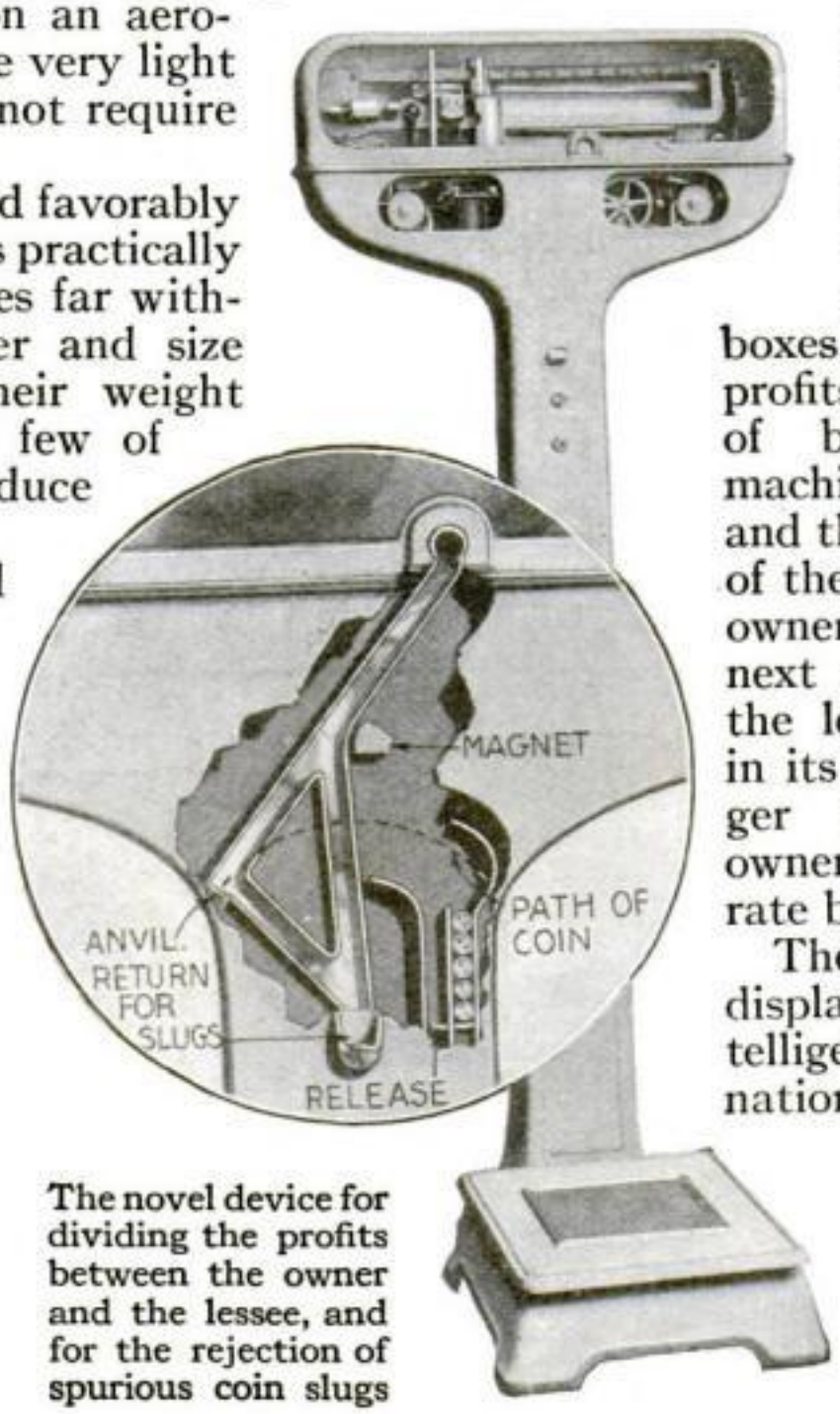
The fan spins like a great pin-wheel when the aeroplane is under way and produces the power to drive the dynamo

Making the Aeroplane Generate Its Own Power for Wireless

TELEGRAPHING from aeroplanes by wireless has become an ordinary occurrence in the European war zone. But some trouble has been encountered in securing the power to send the messages. The wireless transmitter on an aeroplane must, of necessity, be very light and compact, but it does not require a great amount of power.

Batteries are not regarded favorably for the purpose because it is practically impossible to send messages far without increasing the number and size of the batteries until their weight becomes prohibitive. A few of light weight will not produce sufficient voltage.

By far the best plan tested thus far involves the use of a small dynamo which generates directly the alternating current necessary. It is arranged to be driven through gears or by a belt from the main gasoline motor of the aeroplane. Or it may be driven indirectly by means of an "aerofan" as shown in the illustration. This fan spins like a great pin-wheel when the aeroplane is under way, producing power to drive the dynamo.



The novel device for dividing the profits between the owner and the lessee, and for the rejection of spurious coin slugs

An Unusually Fair-Minded Slot Machine

THE weighty question of the gain or loss of avoirdupois which is so often asked of the slot machine, may henceforth be brilliantly answered by an automatic electrically-operated beam-scale, which is claimed to be very accurate and practically infallible in its measurements. The machine is coin-operated and possesses many novel features.

When the person to be weighed steps upon the platform and drops a coin into the slot, a small interior electric light is turned on and the large weight moves to the proper position on the balance-lever. Then the small weight which measures pounds and fractions of pounds moves out to the balancing position and stops. The balancing weights are drawn along the beams by small motors which are automatically cut off when the beam balances. The interior light enables the patron to read clearly the weight indicated.

The invention also embodies a novel percentage-paying device, separating the cash into two cash boxes, one intended for the profits resulting to the place of business where the machine is being operated and the other for the owner of the machine. When the owner's slot is filled, the next coin is diverted into the lessee's cash box and in its course strikes a trigger which releases the owner's cash into its separate box.

The machine, moreover, displays almost human intelligence in the discrimination which it makes between the genuine coin of the realm and counterfeits or slugs, invariably handing back to the customer any substitution.

Teaching Music by the Picture Method

ONCE in the days almost beyond recall, learning the alphabet was the first step toward a possible college presidency; but now children are taught to read at the very beginning of their school work. They learn to visualize phrases and sentences by associating pictures with groups of words, and they get through several story books in the course of a year instead of one little primer.

The same sentence-word-phonetic method is now being applied in teaching rudimentary music. An electrical apparatus called a "music optigraph" has been invented for the purpose by B. F. Miessner. It consists of a small keyboard, the keys of which are connected with small incandescent bulbs behind a musical staff printed on glass, on which any combination of notes from two to five in number, within the range of an octave and a half, may be flashed before a student. Thus, whole phrases are visualized at once, instead of being pieced together note by note; just as, for instance, the picture of a tree and the words "This is a green tree" are visualized by the child learning a language by the modern method.

The range of the instrument is from middle "C" to the "G" above, and musical phrases are flashed by pressing lettered push-buttons corresponding with the notes desired. The staff lines are printed on dull, semi-transparent sheets of pyrolin or celluloid, behind which are the flashlights. The notes appear on the lines and spaces of this staff as solid ovals of soft red light when the buttons are pressed. The instrument is self-contained in a mahogany case resembling a suit-case. The upper part contains the staff, lights, etc., and the lower part the push-buttons, batteries and pitch pipes. The flashlight type of battery is used.

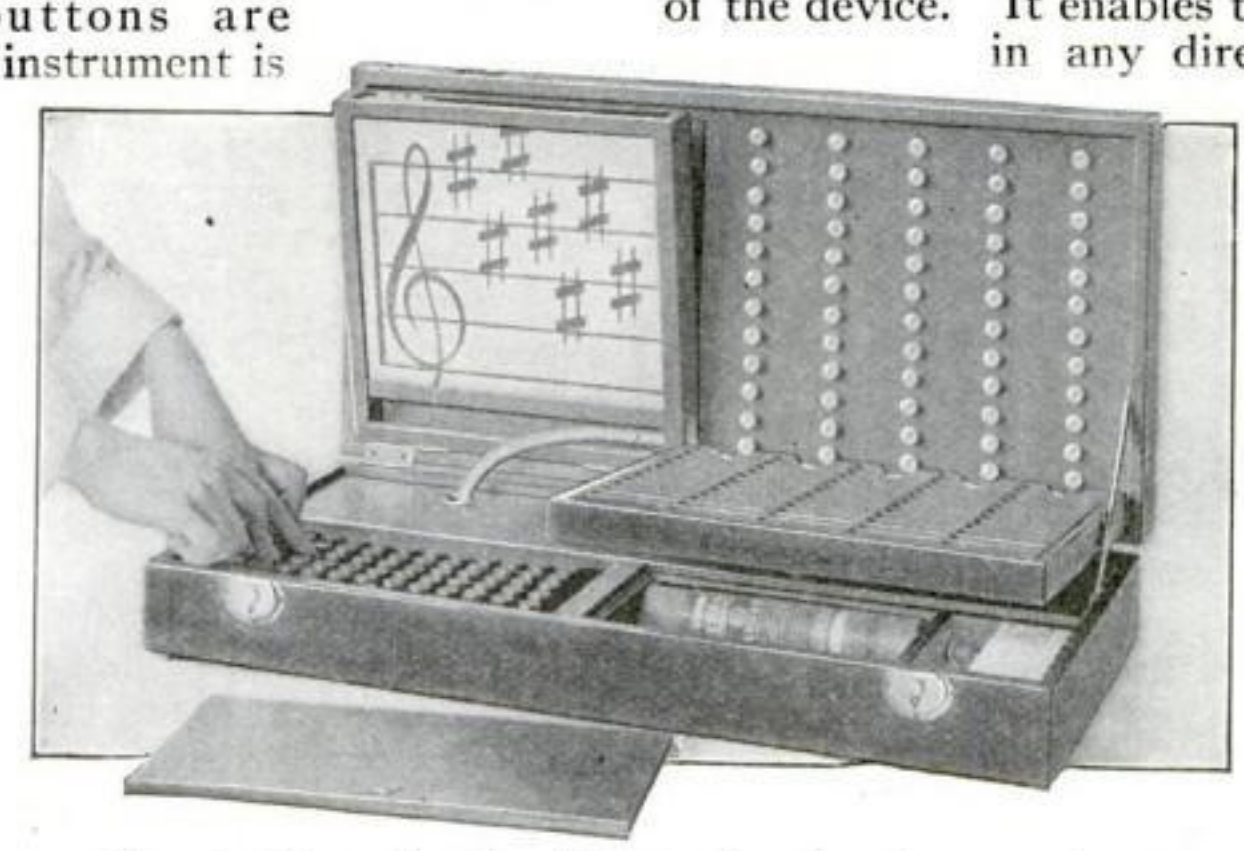
The lamp has thirty feet of cord wound around a reel. A swivel enables it to be extended in any direction

An Extension Reel for Electric Lamps

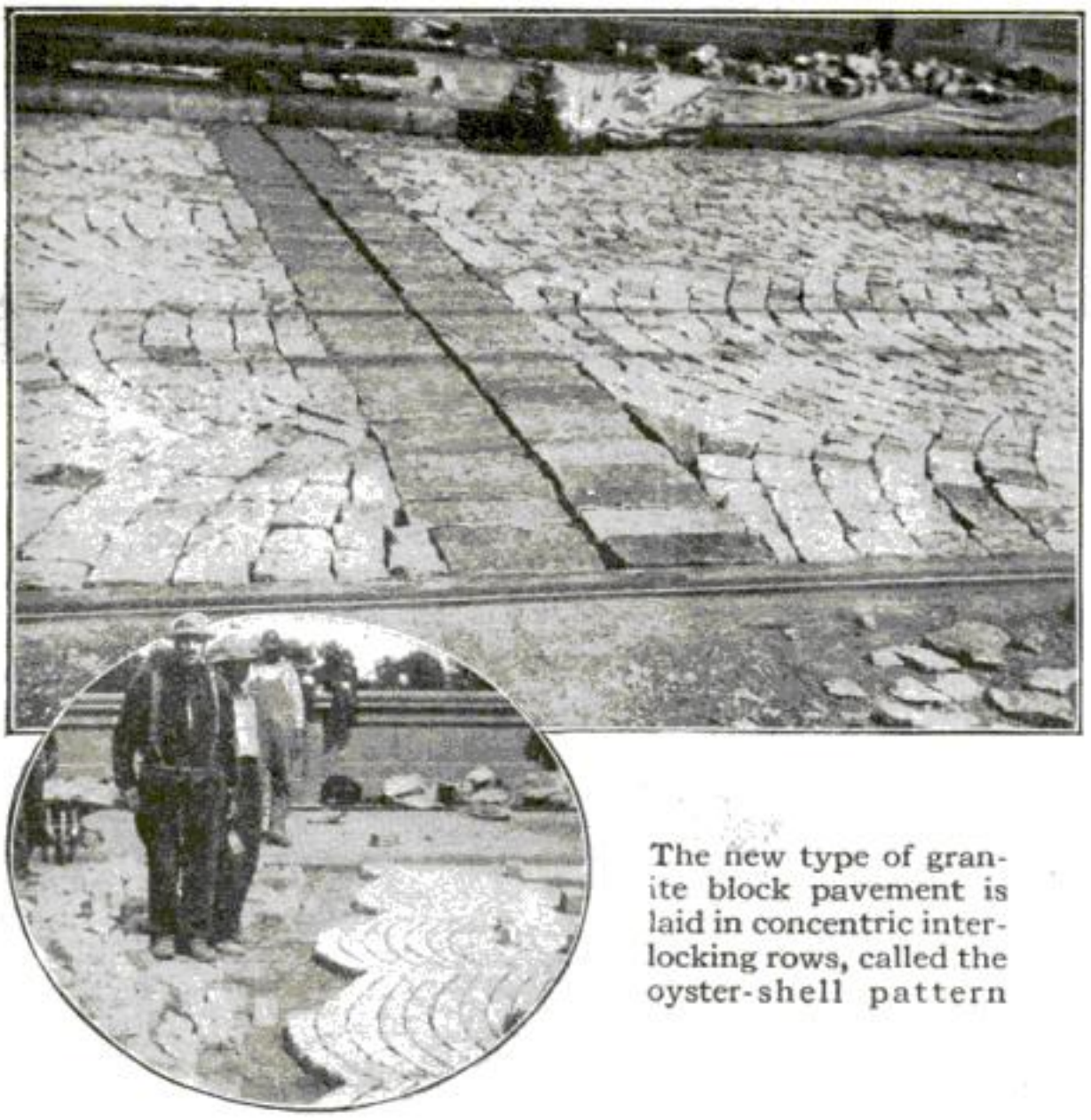
WHEREVER an extension light is needed or desired, as in garages, blacksmith shops, factories, stores or even in the amateur workshop, this automatic reel for the cord will be appreciated. It is equipped with thirty feet of lamp-cord and is secured to the wall or any other convenient place through the arms of a swivel-joint.

This swivel-joint is a special feature of the device. It enables the man to walk in any direction with the light. An automatic lock is provided to hold the lamp any specified distance from the reel.

When it is desired to shorten the cord, a slight forward pull unlocks the ratchet, the reel revolves and winds the cord back.



The electric optigraph which teaches the elements of music by causing the pupil to visualize whole phrases at once



The new type of granite block pavement is laid in concentric interlocking rows, called the oyster-shell pattern

of substantial and comparatively cheap concrete base material.

The method of laying the blocks as followed on the new Brooklyn-Brighton viaduct in Cleveland, Ohio, is typical. They are laid in a cushion of dry sand and cement, mixed in the proportions of three parts of sand to one of cement on the concrete base. What is laid one day is thoroughly wetted down at night so that the blocks are made practically integral with the base. The joints between the blocks are then filled with a mortar of one part of fine sand to one part of cement. In Cleveland the contractor is paid $2.50 per square yard for labor and material for the cushion, blocks and grout. The cost of base will depend on its depth. Small granite cube pavements have been used extensively in many English and European cities as well as in South America for several years.

The Old-Fashioned Heavy Paving-Block Gives Place to a New Form

A NEW type of granite block pavement, almost as smooth and as easily cleaned as asphalt, is finding favor as a wearing surface for streets of dense traffic. Instead of heavy rectangular blocks seven and eight inches deep, the new practice is to specify cubical blocks of from three and a half to four inches, the depth of the ordinary brick.

The new type is laid in concentric interlocking rows, called the oyster-shell pattern. Because of smallness of the block and the apparent irregularity of joints, a good foothold for horses is obtained. Another advantage is that opposite wheels of the vehicle are not on the same course, thus lessening shock and more evenly distributing the load on the base. The small block also allows more of the depth of the pavement to be made up

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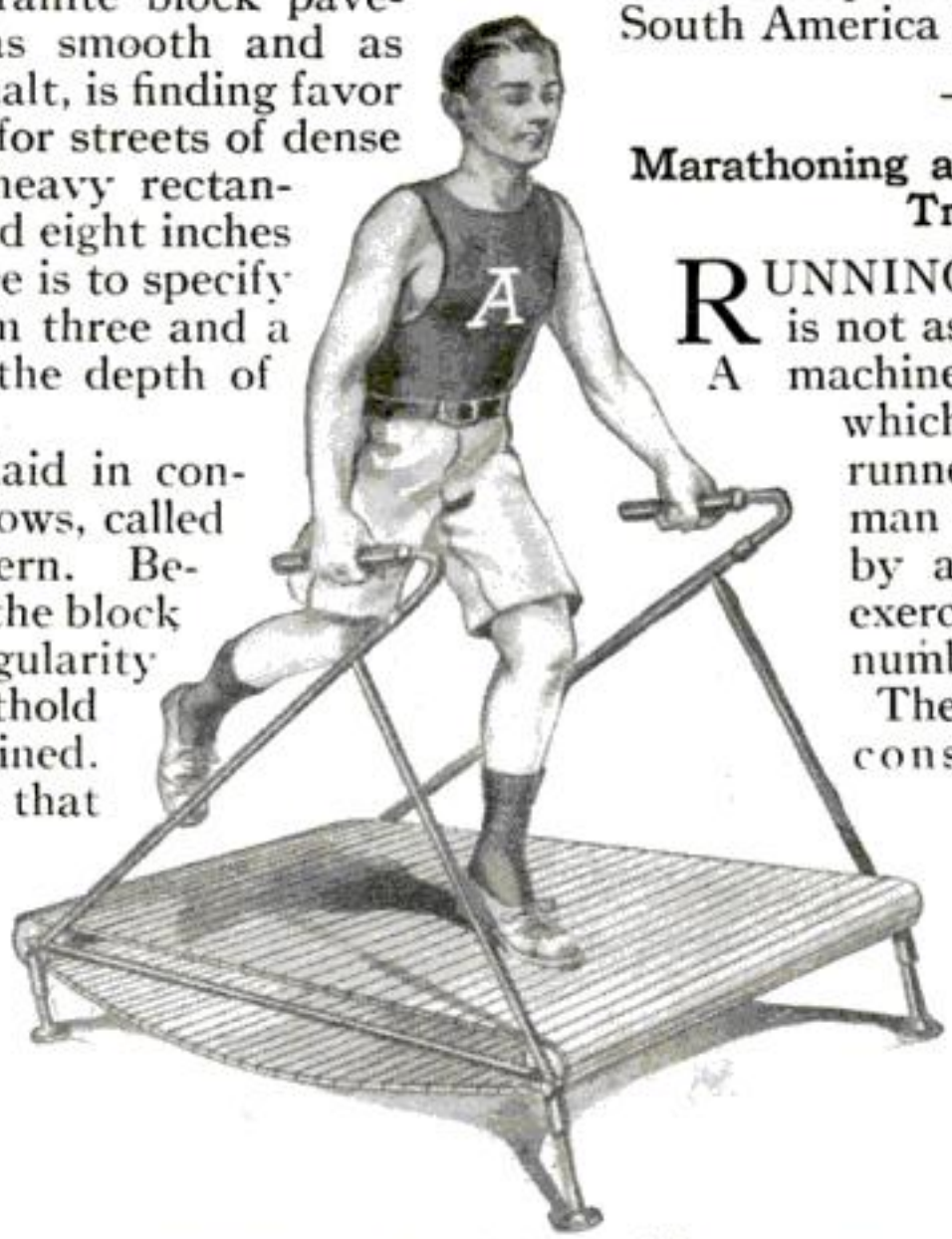
Marathoning at Home on a Special Tread Mill

RUNNING a marathon at home is not as difficult as it sounds. A machine has been devised which makes it easy for the runner, including the fat man who wishes to reduce by adopting this form of exercise, to run at home any number of miles he desires.

The machine as illustrated consists of a wooden tread tightly drawn over rollers. The whole apparatus is supported on steel legs, and when not in use can be folded up. Handlebars enable the runner to exert an additional force while he is running, and prevent him from falling off.



Simply grasp the handlebars, pick out some imaginary object on the distant horizon and expend your energy in an effort to catch it

An Electric Endless-Chain Barge-Loader

A LARGE jobber of building material at Wheeling, West Virginia, recently had a serious problem to face in the way of expensive handling of materials. On one large contract he had no place to unload his materials from the barges on the Ohio River except at the public wharf. No permanent unloading machinery could be built at that point. It was necessary to shovel the sand and gravel into the dump wagons from the barges. Finally he devised the endless-chain loader shown in the accompanying illustration.

This machine is operated by a five-horsepower motor, and current is supplied by the local electric company. By hand-loading, it required two men fifteen minutes to load a one and one-half-yard dump-wagon, whereas, with the loading machine, the same wagon can be loaded in less than two minutes.

An endless-chain loader built to save time and money in unloading sand and gravel in large quantities

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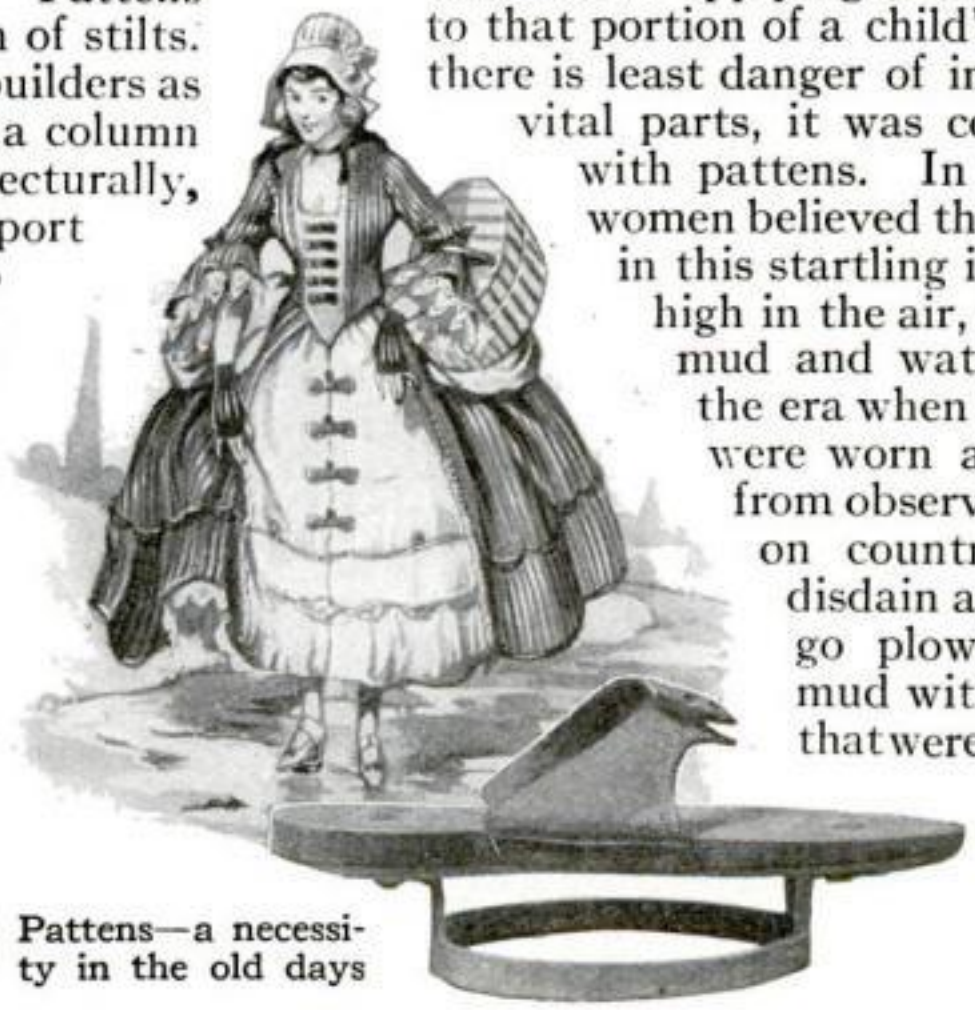
Stilts Instead of Overshoes for Muddy Crossings

AMERICANS find it more difficult than the English to understand what Dickens means when he says in *David Copperfield*, "Women went clicking along the pavement in pattens." Pattens were an abbreviated form of stilts. The word is also used by builders as the name of the base of a column or pillar, and so, architecturally, the patten is the support used by a woman to keep her out of the water and mud. From this architectural use has come the secondary application of the word, meaning an arrangement attached to the shoe, as shown in the illustration, so that the walker is raised three or four inches above the solid earth. If the mud and water did not exceed that depth the shoes were thus kept fairly dry.

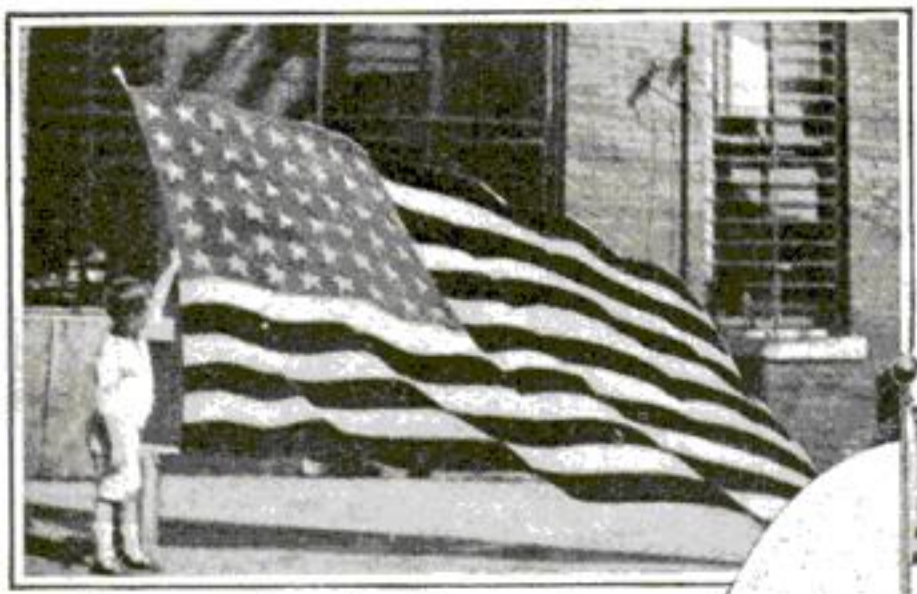


Pattens—a necessity in the old days

It appears that pattens were not worn solely by the rich, but were luxuries indulged in by the very poor. In speaking of a person who was not especially speedy, Ben Johnson uses the comparison, "You make no more haste now than a beggar upon pattens." In the ballad of *Farmer's Old Wife* occurs this startling expression: "She up with her pattens, and beat out their brains."

This would lead us to believe that although the mothers of those days may have believed in applying a slipper occasionally to that portion of a child's anatomy where there is least danger of inflicting injury to vital parts, it was certainly not done with pattens. In those early times women believed that they must walk in this startling inconvenient way, high in the air, to keep out of the mud and water. Then came the era when rubber overshoes were worn and now, judging from observations made even on country roads, women disdain any protection and go plowing through the mud with thin low shoes, that were white once. There is an awful series of degenerations from the patten to white slippers in the mud.

Flags Made of Wire. They Wave Even When There Is No Breeze



Flags made of wire mesh mounted on a round iron-rod frame wave forever without becoming tattered

WHEN a flag has been tattered in battles its dilapidation bears witness to heroic service. It calls up pictures of brave deeds and victories won. But the flags that flutter in the breeze over our public buildings are anything but insignia of glory when they become ragged after a period of service.

F. C. Wardell of Boone, Iowa, has conceived a plan to banish the perishable bunting and silk flags except for special occasions, by substituting one made of wire mesh mounted on a round iron-rod frame. The one in the accompanying photograph was modeled from a composite picture of about fifty photographs of a cloth flag in various degrees of wind. It has been mounted on Ensign Peak, Salt Lake City, Utah, as shown in the oval picture.

In position the flag seems to be floating in the breeze, but the undulations are only imitations. The wire mesh is practically indestructible, and it can be painted again and again.

To those who are really patriotic such a flag seems a boon. It not only offers a means whereby the appearance of a locality is distinctly improved but it implies a desire to keep the symbol of national loyalty fresh and well-preserved. Its cost is comparatively small.

A Caterpillar Three Hundred Feet Long

THE Ferracute Machine Company of Bridgeton, New Jersey, on being asked to take part in a local parade, put the matter up to its employees, who conceived the idea of constructing the giant caterpillar, shown in the accompanying illustration.

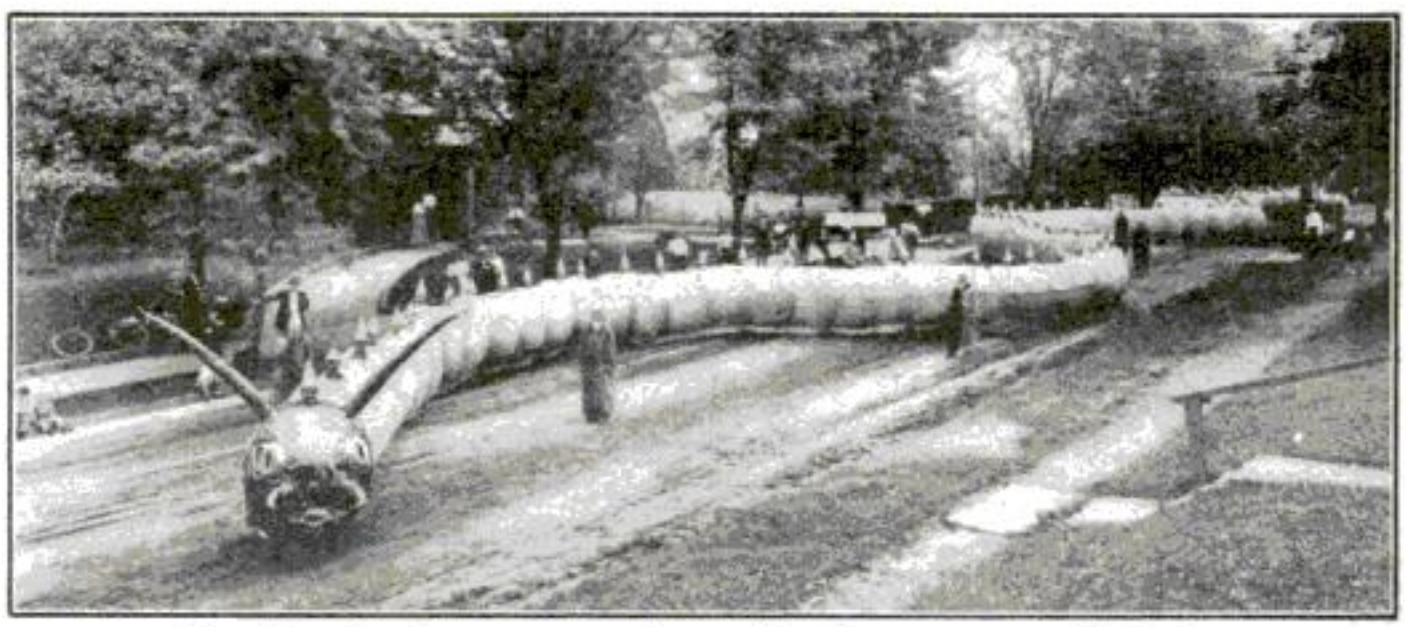
Works on Lepidoptera were searched in vain for models, and being thrown on their own resources they took a living specimen and magnified its hideousness. The caterpillar they made is three hundred feet long and nearly five feet in diameter, with a head containing features hitherto unknown.

The motive power was supplied by a hundred men wearing pointed caps, ranged three feet apart, the heads and caps projecting through the back. Four hundred yards of green muslin composed the skin, the head consisting of a light framework covered with paper and appropriately painted. The eyes were made of new tin dish-pans, inverted, which reflected rays of light in a striking manner.

There were a number of unique features in the parade, but the caterpillar, as it wended its sinuous way through the streets and up-and-down hill, caused the greatest sensation and amusement, so that the participants were given first honor.

The photograph was taken directly in front of the attractive office of the Ferracute Works.

No, the parade was not a feature celebrating the seventeenth of March, although the good St. Patrick would probably not have quailed even before such a monster.



One hundred men, wearing pointed caps, supplied the motive power for this three hundred-foot long caterpillar

An "Armless" and Inconspicuous Baby Carrier

AN apparatus, the principal aim of which is to eliminate the element of drudgery from the operation of conveying an infant from place to place, has just been invented by W. J. Sprong, of Los Angeles, California. The carrier may be used either in the home or upon the street; while the mother is doing the work about the house, or at the time of her shopping tour. One of the features of the device is that when it is used both arms of the person carrying the child are practically free to do other things. Another point which is important is that by its use the shoulders and back are forced to take the weight of the child, rather than the arms. Practically no effort is needed to carry the average baby. With this device in use the go-cart may be left at home, while on rainy days the infant's feet need not be permitted to touch the pavement.

With this carrier the shoulders and back are forced to take the weight of the child

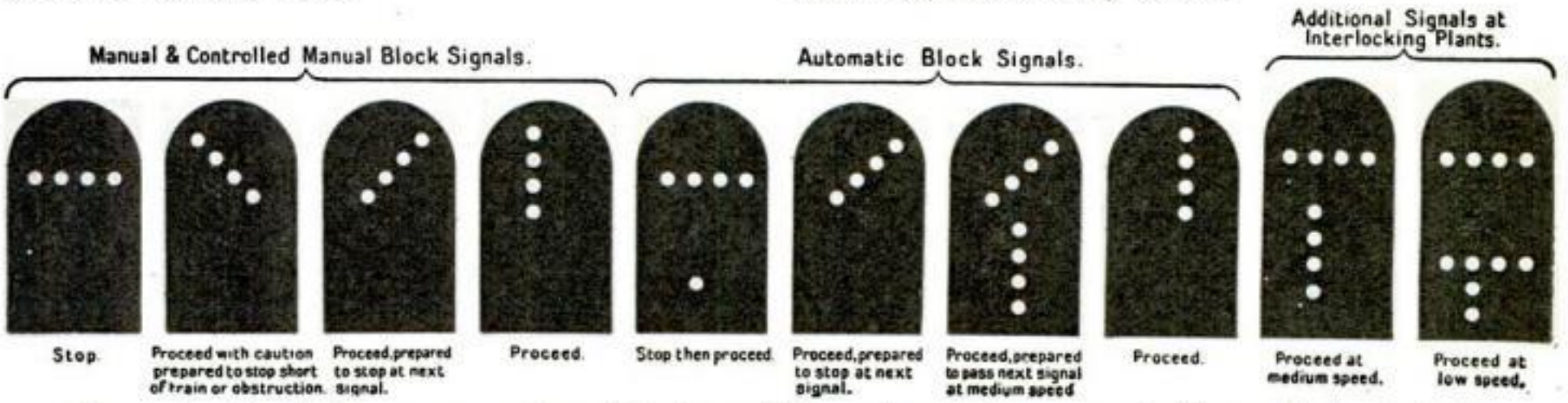
The device may be used with equal comfort either upon or beneath the outside clothing. The part of the carrier which holds the baby may be attached to and detached from the shoulder "harness" in an instant, the basket section being so small that it takes up no more room than a good-sized handkerchief when rolled up and placed in the purse or handbag. It is made of a fabric material and is adjustable to any size.

Daylight Lamp Signals Will Take the Place of Semaphores

A NEW system of signaling which dispenses with semaphores and colored lamps has been adopted on the Pennsylvania Railroad. All indications, both by day and by night, are given by rows of white lights corresponding with the positions of semaphore arms. The system has been in use for more than eighteen months on the twenty-mile line from Philadelphia to Paoli. This line has four tracks and it is one of the latest examples of railway electrification. There is heavy suburban and general traffic and the blocks are three to four thousand feet in length.

In 1914, Dr. Church discovered the possibility of securing long range from a small lamp arranged in the exact focal center of a small wide-angle lens. Following this and in conjunction with Mr. A. H. Rudd, Signal Engineer of the Pennsylvania Railroad, the new signaling system was developed, in which separate light units arranged in rows represented the positions of the semaphore blades, dispensing entirely with the use of lights of different colors. After extensive experimenting, the system was perfected and put into actual service. The signals are used both at block sections and at interlocking plants and are operated both automatically and manually.

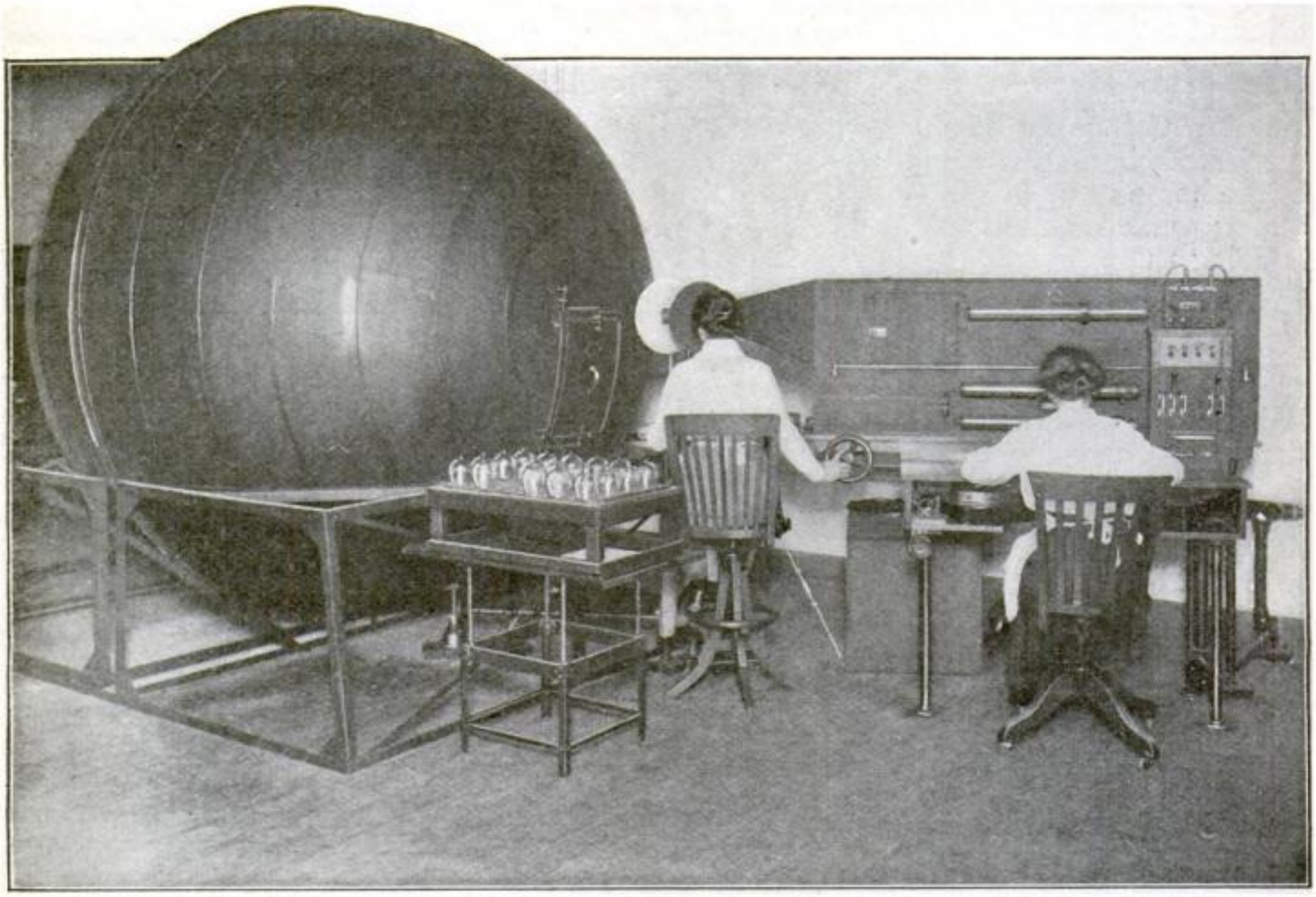
In the opinion of Mr. Rudd, light signals are the coming type, and will supersede the present semaphore signals. The only alternative is the possibility of an automatic speed-control system for trains, sufficiently reliable to preclude the necessity for fixed signals of any kind.



Rows of white lights corresponding with the positions of semaphore arms indicate all signals both by day and by night. These new signals have been given the name of "position lights"

A Quick Method of Measuring Light

The greater the size the greater the accuracy as a measuring instrument where this kind of a sphere is used



A one hundred-inch sphere photometer used for light-testing work. A sight box, large photometer-bar, movable comparison lamp and scale graduated in millimeters are essential elements

THIS queer-looking apparatus, suggestive of the rind of some Brobdignagian watermelon, is devoted to the innocent purpose of measuring light. We say "rind" advisedly, for the sphere is hollow. It is of a dark color on the outside, and, like the melon rind, white inside, but there the similarity ends, for instead of pulp and seeds one finds at the center of the sphere a whitened fixture designed to hold the electric lamp which is to be tested. The instrument is located at the Nela Park laboratory, in Cleveland.

Light from the test lamp issues through an opal window in the outer shell and falls on a comparison-screen. In the illustration this screen is being observed by the young lady sitting at the left. Inside the long box at her right is a sliding lamp of known candlepower, against which the test lamp in the sphere is measured.

The apparatus is known as an Ulbricht Sphere; the original form was invented in Dresden by Prof. R. Ulbricht. It operates on the well-known principle that the interior of a whitened enclosure of this kind is of approximately uniform brightness, and can be used to measure the total light output of a lamp, as distinguished from its candlepower in any one direction.

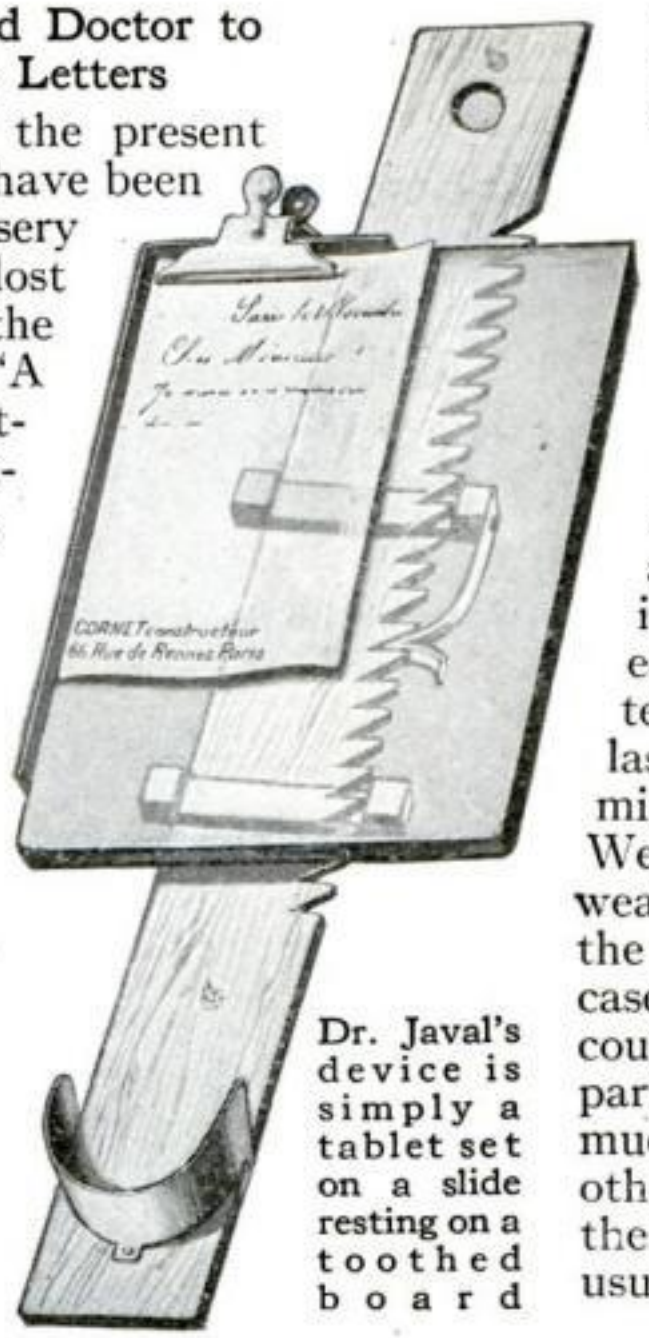
The principal application is in the measurement of large gas-filled lamps, which, on account of the peculiar coiling of their filaments, vary widely in candlepower distribution and can be rated quickly and accurately only on such an instrument.

This particular Ulbricht Sphere, one hundred inches in diameter, cost several hundred dollars and is the largest in the country. The greater the size, the greater the accuracy as a measuring instrument, since the percentage of reflected light to absorbed light is increased.

The value of the Ulbricht invention as a time-saver may be illustrated by the fact that with its aid five minutes suffice to make measurements that would require fully half an hour under former methods.

A Device Invented by a Blind Doctor to Enable Himself to Write Letters

THE greatest sufferers of the present war are the soldiers who have been blinded. To palliate their misery French soldiers who have lost their sight are urged to use the suggestions of a book called "A Blind Man to the Blind," written some time ago by a scientist, Dr. Emile Javal, who, when he found his sight going, tried to prepare himself for his days of blackness. Dr. Javal managed to write the book with his own hand. The device he invented is shown in the accompanying illustration. The difficulty in writing without seeing is that although the first line may be fairly straight the following lines are apt to overlap. Dr. Javal's invention consists of a tablet set on a slide resting on a toothed board. The catch of the slide is pressed by a spring into one of the openings between the teeth of the board, thus forming a kind of rack-bar. The end of the board has a rest for the elbow, which rest keeps the pen at a fixed distance from the end of the slide. By means of the catch and spring the tablet is moved at the end of each line and set in place for the next line. The paper is held on the tablet by a clip; the end of a line can be revealed by the sense of touch.



Dr. Javal's device is simply a tablet set on a slide resting on a toothed board

Dr. Javal made constant use of his tablet until his death. Men of little education can hardly gain as much benefit from such inventions, but as the blind should be encouraged in the use of whatever preserves their individuality, soldiers who have lost their sight will be taught the use of some such method of expressing their thoughts. A plain, unvarnished recital of any one man's experiences in the war would be of real literary value.

Why We Remember Those Big Snow-Storms of Youth

WHY do most people believe that the winters were more severe and were attended by heavier snowfall in their childhood days than they are now? The myth of the "old-fashioned winter" is almost universal, and is another example of "counting the hits and not the misses." Heavy snow and intense cold produce a more lasting impression upon the mind than open, mild weather. We remember the exceptional weather of the past, and forget the normal weather. In some cases a change of residence accounts for this belief. Some parts of the country have a much heavier snowfall than others. In any given locality the weather conditions are usually uniform.

A Medicinal Cartridge-Belt for Peaceful Expeditions

THE man who is hunting for health instead of for wild animals can wear a medicinal cartridge-belt recently devised by Dr. Otto Sommer, of Seattle, Washington. The belt is made of canvas or leather, as desired, and it has numerous compartments for vials containing medicine, just as a cartridge-belt has holes for cartridges. When a person wearing the belt wishes to take a shot at some internal disorder he plucks a medicinal pellet from the belt and swallows it. If relief does not follow he plucks another of a different kind until his medicinal ammunition is depleted.

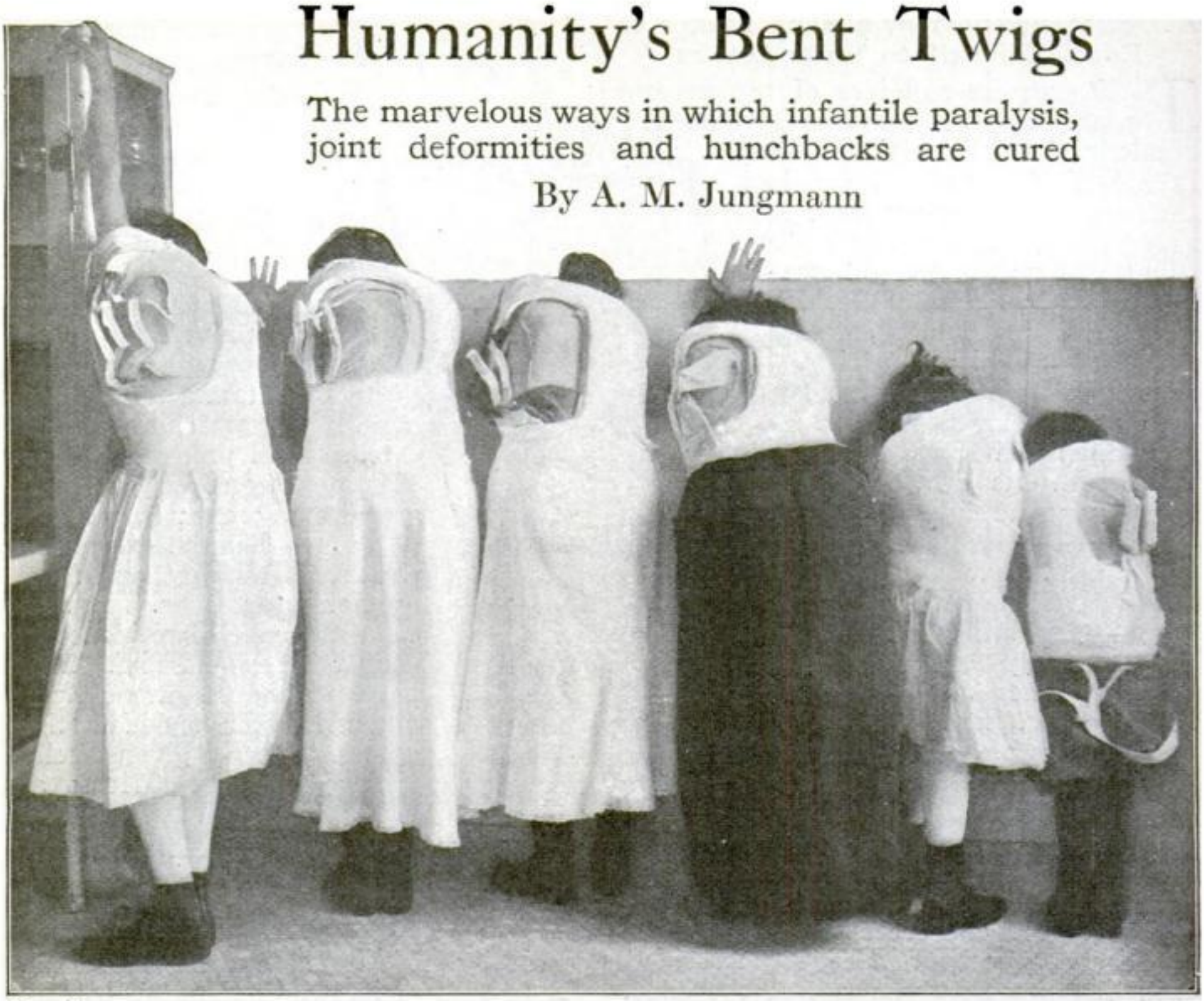
At this point he dons another belt fully loaded and repeats the operation. The inventor claims the belt is useful on long walks, trips, and on horseback expeditions.

The medicine vials are placed in separate compartments in the belt as if they were so many cartridges

Humanity's Bent Twigs

The marvelous ways in which infantile paralysis, joint deformities and hunchbacks are cured

By A. M. Jungmann



A group of patients wearing plaster-casts to correct deformities of the spine. When the casts are finally removed the backs are as straight and strong as nature intended them to be, and remain so

FOUR years ago a young Italian couple living in New York looked forward with eager anticipation to the arrival of their firstborn. They hoped it might be a boy. It was. But their joy was much clouded because the child had no feet. There were no ankle-joints—nothing but a large leg-bone. Just below where the ankles should have been the legs terminated in points. Here was a great misfortune. Never could the child walk. Except for this defect the baby was as fine a boy as one would wish to see.

The other day I saw that baby, now grown to four years of age, run across a ward of the Hospital for Deformities and Joint Diseases in New York city. He ran on flesh and blood feet, not as well, perhaps, as though he had been born with them. But he ran. And we are taught that the age of miracles is past! In orthopaedic surgery it is just beginning.

The boy's parents had heard of the remarkable cases of corrected deformities which the Hospital for Deformities and Joint Diseases has to its credit, and took him there. They hoped that some mechanical means might be found to enable him to walk—something in the nature of a brace, perhaps.

Dr. Henry W. Frauenthal, the distinguished orthopaedist in charge of the hospital, determined that through an operation the child could be provided with feet made from his own bone and flesh. Accordingly the leg-bones were broken at the place where the ankles should have been and then reset at right angles, to form feet. To be sure, these feet have not the spring, the resilience, of natural feet; but the boy need never be dependent on others because of his inability to walk. His general health will be much better, since he may exercise naturally.

Each day five hundred afflicted persons attend the clinic at the Hospital for Deformities and Joint Diseases. It is the only New York hospital that accepts chil-

dren under four years of age and over sixteen. This explains the size of the clinic, one of the three largest in the world. Under the Frauenthal method a young baby may be treated for deformities, such as club feet and hands, because the hospital accepts children from birth. At the time of my visit to the hospital for the POPULAR SCIENCE MONTHLY, the youngest patient

Above: Exercises to regain control of paralyzed muscles and to straighten spines

To the left: Adjusting a traction splint to correct a shortened leg

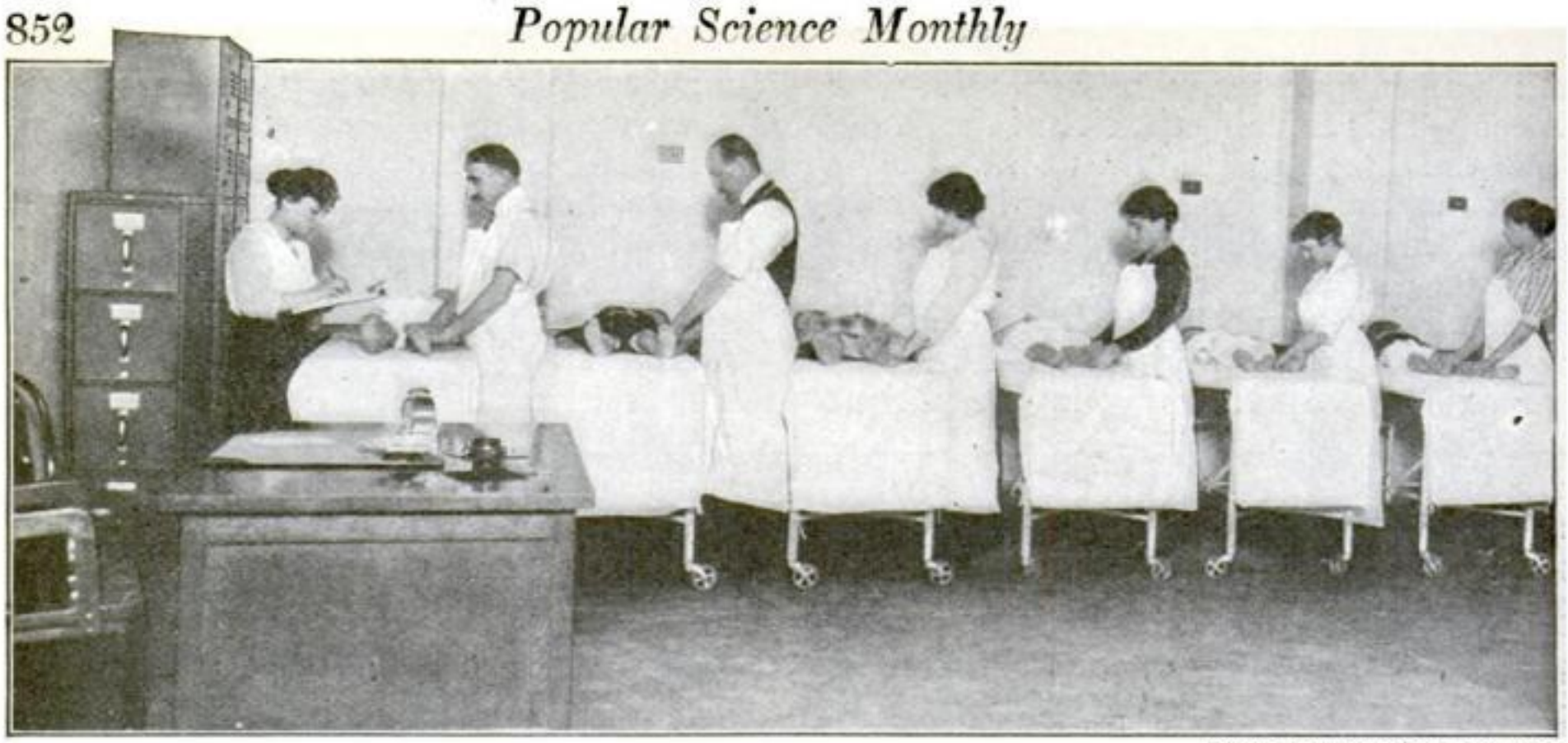
was four days old. Cases requiring hospital treatment are accepted and kept in the institution until their difficulties are overcome, if they have to remain a year.

Before the hospital was established a man suffering from a chronic affection of a joint, for example a knee joint, would have been sent from one hospital to another until, in despair, he would finally consent to have the leg amputated. The ordinary hospital is not equipped for orthopaedic work. Its facilities are overtaxed in caring for acute cases. There is neither time nor room to treat chronic cases. Think of the terrible human waste this means. Think of suffering an amputation because there is no place where one can go where a diseased joint can be restored. A man lacking an arm or a leg depreciates in value to himself and to the community.

Cleaning Teeth to Save Lives

The science of orthopaedy has some amazing features. Many men—and women—have been rescued from living the lives of hopeless cripples simply through having their teeth cleaned. It seems incredible; yet it is true. The easiest way to bring it home to you is to tell you the stories of some of the sufferers who have been cured by this extremely simple means.

A detective who had to walk much, suddenly began to experience trouble with his feet. For two years he was treated for fallen arches. He could not obtain relief. His feet became more painful every day. At last he was advised to go to the Hospital for Deformities and Joint Diseases. By



Picture continued on next page

A group of children suffering from infantile paralysis receiving massage. These patients generally are under five years of age, although the disease sometimes attacks much older children

that time his pain had become well nigh unbearable. He could not move about even with the aid of a cane, and was forced to give up his work. At the hospital his teeth were cleaned. Two weeks later he was free from pain. He discarded his cane and arch supports and returned to work without suffering the slightest inconvenience from his feet.

This case was diagnosed as infectious arthritis, which means an inflammation of the joints caused by an infection. The infection which caused all the trouble had its origin in septic pyorrhea, a disease of the gums, sometimes called Rigg's disease, caused by an infection of the tissues surrounding the teeth. Particles of food lodge in the crevices of the teeth, decay, and become breeding grounds for germs. Tartar forms at the base of the teeth in little pockets. If this is neglected, small pockets of pus develop which fill with bacteria. The pus discharges in minute quantities, passes into the throat and enters the intestines. Sometimes the micro-organisms it carries establish themselves in the tonsils. The result? Tonsilitis. If the bacteria pass into the alimentary canal they are absorbed by the system and set up inflammation at the point offering least resistance. This frequently is found in the knees, elbows, or the joints in the feet. Do you wonder now what was the matter with the detective?

Sometimes people suffer for years from what they consider inflammatory rheumatism. They resign themselves to a life of pain when all that is necessary to obtain relief is to have their teeth cleaned. One woman, treated at the Hospital for Deformities and Joint Diseases, suffered so from this form of joint infection, which she thought was rheumatism, that she twice tried to commit suicide. For nine months she was without the use of both knees, both wrists and the left ankle. She was bedridden. She was carried into the hospital on a stretcher. Ten days after her teeth were cleaned she walked out a well woman.

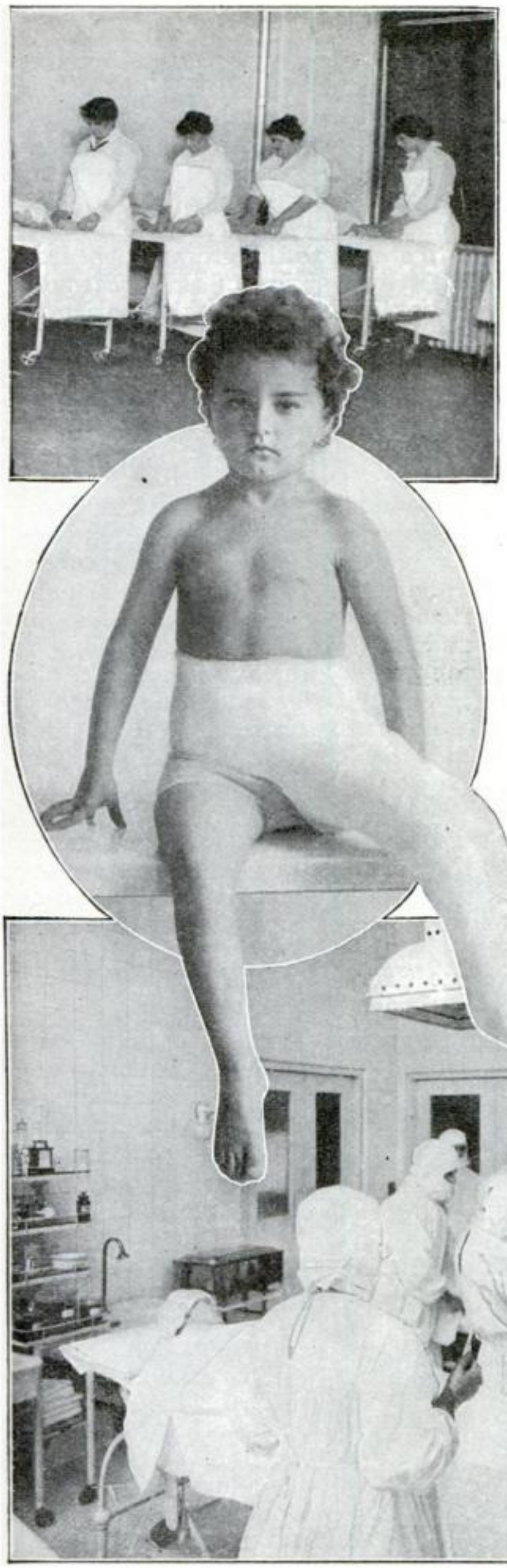
The Effects of Infantile Paralysis

Actual deformities may be caused in children and adults by a number of diseases chief among which are tubercular affections of the bones, of the spine (Potts Disease), infantile paralysis and venereal diseases.

Of these perhaps the most spectacular is infantile paralysis. It is given that name because it attacks children and paralyzes its victims. It is communicable. New York experienced an epidemic in 1907, and during the past summer another swept over certain districts of the city, causing the greatest anxiety and terror among parents. And well it might; for the most wholesome, sturdy child may be reduced to a hideously deformed cripple through its ravages.

At the Hospital for Deformities and Joint Diseases there are always a number of children undergoing treatment for infantile paralysis. The disease is prevalent, more or less, all the time. But the general public hears little of it, unless, as was the case last summer, it becomes epidemic.

The Frauenthal method of treating this disease has effected some brilliant cures in cases which had been regarded as hopeless.



A sixteen-year-old boy was treated at the hospital for paralysis of the face. When he was one and a half years of age he suffered an attack of infantile paralysis which resulted in loss of control of the muscles of the right side of his face and of his right arm. For fourteen years, day and night, that boy's right eye was staring open. He could not close it. He could not use his right arm. His appearance was repellent. After six months of treatment he was able to close his eye and to wrinkle his forehead. The affected side of his face became normal.

Dr. Frauenthal treats infantile paralysis by means of electricity and massage. Whatever muscles are affected are also treated electrically. A muscle which cannot be contracted by will, may be contracted by an electric current. In this way the muscles which do not respond to the patient's will are kept active and developed until they can be controlled by the mind. The treatments last but a few minutes at a time, so that the child's vitality is not exhausted. The current is so carefully regulated that the child does not feel any pain.

Massage is given regularly. If a child's arm or leg is affected by infantile paralysis that limb is strangely cold. Massage will raise the temperature of the affected member

A boy being treated for tubercular joints. He is wearing a plaster cast over the affected hip and knee

The operating room, showing the surgeons completing an operation on a diseased knee-joint, and a group of visiting surgeons watching. On another cot is a patient waiting under an anaesthetic

from 6 to 10 degrees Fahrenheit. Heat is necessary to the development and growth of the limb. Hot baths are also given to float the limb and aid in acquiring motion.

The most interesting part of the treatment is the exercising done before a mirror. The little patient is told to concentrate his mind on the affected part, whether an arm, a leg or any group of muscles, and to endeavor to move those muscles. The mirror stimulates him to put forth his best efforts because he takes keen interest in watching what he does.

What Causes Hunchbacks

Tuberculous disease of the spine (Potts disease), unless checked, leads to the deformity commonly called hunchback. Children under three years of age are held in bed in an apparatus which gradually restores them to a normal position. Any day you may see a row of these little patients on the balcony of the hospital. Despite the fact that they are strapped in an apparatus, which must be painfully confining to a liberty-loving, active child, they are a happy, cheerful lot.

The average case receives surgical operation. A piece of the shin-bone is removed and placed in the diseased portion of the spine as a wedge. The child is then placed in an apparatus which keeps his body rigid. Here he lies for six months following the operation. The cots are on a balcony which overlooks a park. The patients get all the air and sunlight it is possible to get in a city. Strict attention is paid to diet. These children are fed highly nutritious food. After a few weeks of this treatment it is difficult to believe that they are not in the best of health. If it were not for the apparatus which confines them, one would take them for normal children. When they finally leave the hospital they can run and play like other youngsters. And the beauty of it is, they grow up straight-backed.

Hip-disease is another cause of deformity. The affected leg is much shorter than the other. The Frauenthal method of treating this employs carefully adjusted splints, X-Ray treatment and special diet. The child frequently is kept in bed, held in a recumbent position by means of straps. The affected leg is clamped in a weighted apparatus which constantly pulls the deformed member. The hip is treated by the X-Ray to stimulate the growth of healthy tissue. After a period of this treatment, careful diet and fresh air the patient is fitted with a splint in which he can walk. Eventually the disease is eradicated and the short leg induced to grow.

The X-Ray is used extensively in the treatment of joint diseases. For certain joint troubles hot, dry air is used. The patient places the affected member in an electric baker and subjects it to a temperature of from 250 to 400 degrees Fahrenheit. Another interesting apparatus is the Zander apparatus for developing the muscles in weak and flat feet. The foot is strapped to the apparatus, which is then set in motion. The machine is capable of a variety of motions designed to exercise the muscles.

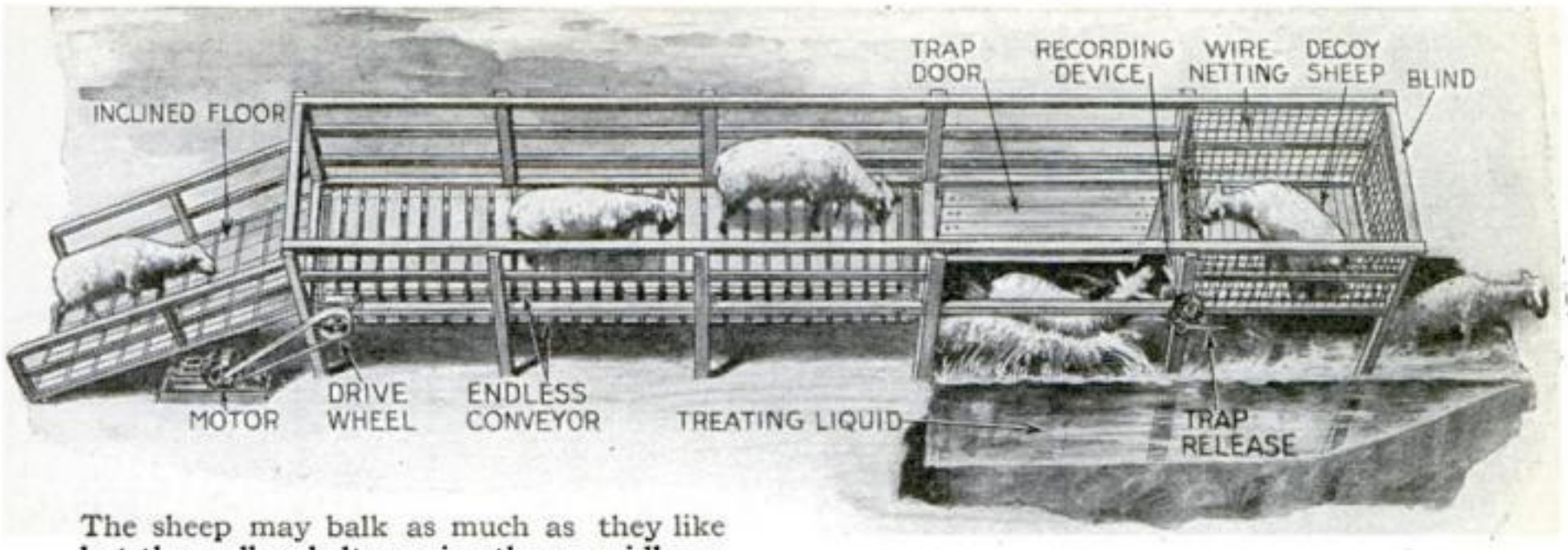
Thanks to orthopaedic surgery the human tree no longer has to incline the way the twig is bent. At the Hospital for Deformities and Joint Diseases five hundred bent twigs are started on the road to straightness every day. They come in on crutches, but they walk out on their feet.

A Rescue Saddle for the Fireman Which Leaves His Hands Free

THE Indian woman carries her papoose strapped in a basket-cradle on her back, because she must needs have her hands free for other things. The same idea has been utilized by William De Lude and Albert H. Steele, of Kansas City, Mo., in the construction of a saddle to be used by firemen in rescuing unconscious or helpless persons from a burning building.

The construction and use of the saddle are shown in the picture.

The victim is held securely by the straps which are buckled to the breastplate and back plate



The sheep may balk as much as they like but the endless belt carries them rapidly on

Sheep May Not Like This But It Saves Time

THE thickness of sheeps' wool provides an excellent lodging place for vermin of all kind. This is undoubtedly warm and comfortable for the vermin, but the sheep and the wool suffer from the unclean presence. On sheep ranches it is the custom to cleanse the stock several times with vermin-destroying liquids before wool-cutting season.

J. J. Roberson, a sheep herder in Utah, who is of an inventive turn of mind, devised a machine which should simplify the performance. In a recent letter to the POPULAR SCIENCE MONTHLY, he writes: "Conservatively, we cut down the cost over one-third by dipping the sheep, to say nothing of the saving in time."

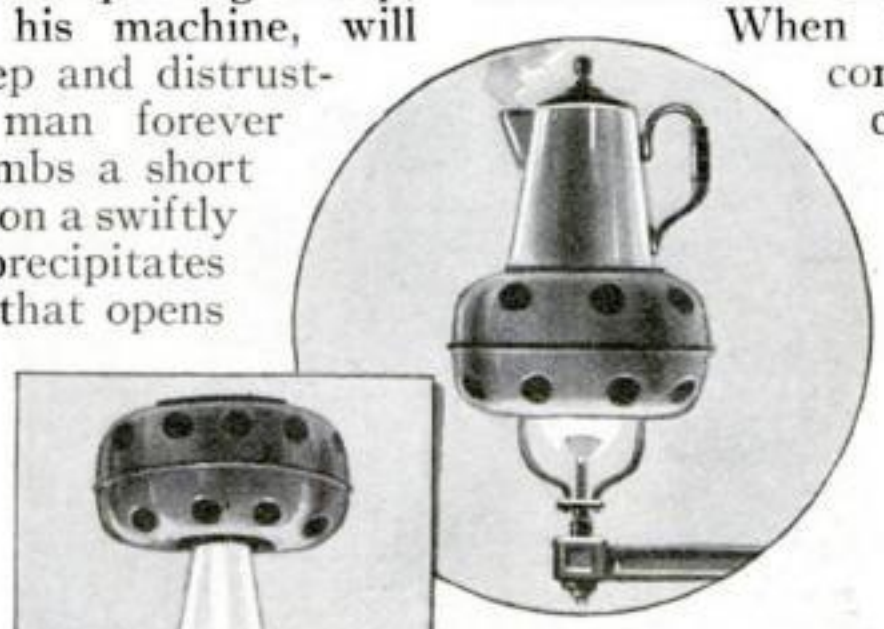
The friendly and unsuspecting sheep, which goes through his machine, will probably cherish a deep and distrusting feeling towards man forever after. The animal climbs a short runway and emerges upon a swiftly moving floor, which precipitates him upon a trap-door that opens assoon as it is stepped upon. The sheep drops suddenly into a pit filled with vermin-destroying liquid.

By the time the sheep has collected its befuddled wits sufficiently to crawl out of the pit upon the open field, the vermin have been completely exterminated.

The ingenious feature of this apparatus is the endless conveyor which takes the animals along to the trap-door no matter how stubbornly they resist—and sheep are the most stubborn of all animals which require dipping. Where one sheep goes all go. That is the inventor's reason for having a decoy sheep in a wire netting to entice the others to go forward.

A Heater for Use Over the Flame of a Gas-Jet or Kerosene Lamp

FOR the small room that is not properly heated, or to use for light cooking in connection with illumination the device illustrated may prove advantageous. The traveler or camper who needs a little hot water for shaving or for a cup of coffee will appreciate it also. It is constructed of sheet-brass with an inner and outer dome. When the inner dome becomes heated, a vacuum is created, drawing the cold air to it through the openings in the outer dome. The heat does not pass through and out at the top, but is expelled in a downward direction. It can be used on top of a gas-jet or over the chimney of a kerosene lamp.



The heat may be utilized for cooking or warming the air without hindering the illumination of the room

Although the construction of the heater is strong enough to accommodate small cooking utensils, the amount of weight which it will sustain is limited. The principal use for which it is intended is to supplement the heat of the furnace or other heating system. It will be found especially useful in the bathroom.

Eight Pictures on One Plate

The camera may not lie but it can be made to play tricks

A SIMPLE attachment for the camera which enables the photographer to secure a number of exposures upon the same plate or film has been invented by Charlie K. Pugh, of Colorado City, Colorado. Two, three, or four pictures may be taken upon different portions of the plate or film without any line of demarcation showing. Four exposures were made to obtain the photograph in the accompanying illustration.

The attachment is a plate of thin metal with the side edges bent inwardly to form flanges to fasten over the camera-lens, as shown in Fig. 8. Affixed to the front of the plate is a rectangular box and tongue, having side walls closed at one end and opened at the other.

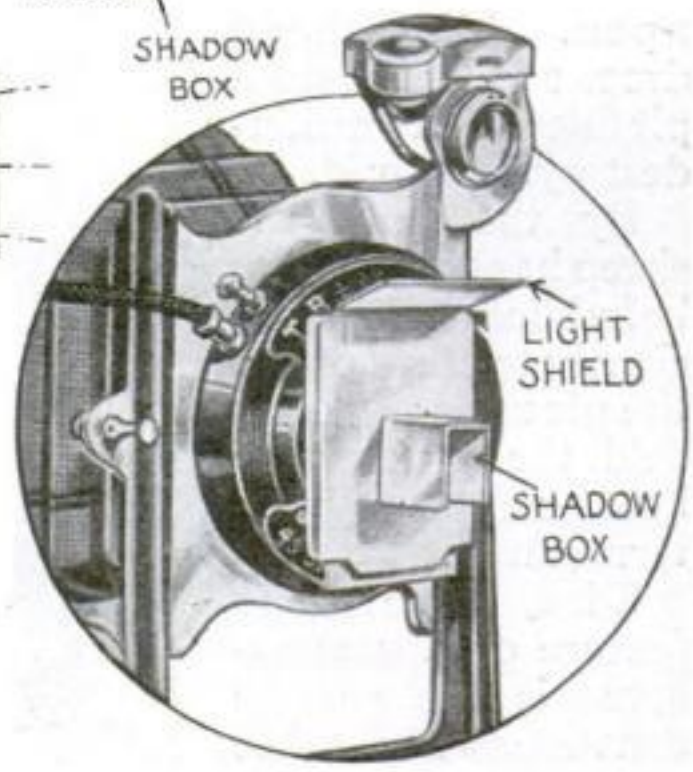
When it is desired to take two laterally exposed views the device is adjusted over the camera-lens as shown in Figs. 1 and 4. In other words, it is so adjusted as to leave an opening for about one half or one third of the diaphragm. A light-shield, acting on the principle of a slide in a plate-holder, cuts off the rays of light which would otherwise affect the other half or remainder of the plate.

When two pictures are to be taken on the same plate, one vertically above the other, the device is in the position shown in Fig. 2. To form the second picture the device is removed and reversed, as in Fig. 3. When four pictures are taken the device is arranged so as to take the two lateral views first, each view occupying one third of the plate. The two middle views are then taken by readjusting the device. This gives four pictures on the same plate, one on the left hand, one on the right, and two in the middle, one above the other.

The tongue in the rectangular box, shown in Figs. 5, 9 and 10, is important, since it cuts off any undesired slanting rays.

This is illustrated in Fig. 10. The light coming in the direction of the middle line is desired; the light rays above or below it are cut off by the tongue.

Details of the camera attachment which makes the multiple picture possible



Things Weigh. Then Why Not Let Them Drop Where They Are Wanted?

THE principle of potential power which Newton investigated and which the baggage-man puts into practice with your trunks, is being utilized in a recently perfected gravity-roller conveyer in warehouses, factories and other industrial establishments where many large packages are handled. In other words, because things weigh, why not let them drop to their destination?

The contrivance consists of a runway of successive rollers on an inclined plane. The great advantages of the gravity method of transportation are that it requires little attention and is extremely flexible. There are switches and other appliances, by means of which the goods may be diverted around corners or shunted wherever desired.

Besides its cheapness of construction and maintenance, it is always ready to accommodate a load and to handle goods as rapidly as they can be put on the runway. Also, breakage is reduced considerably in comparison with hand-trucking.

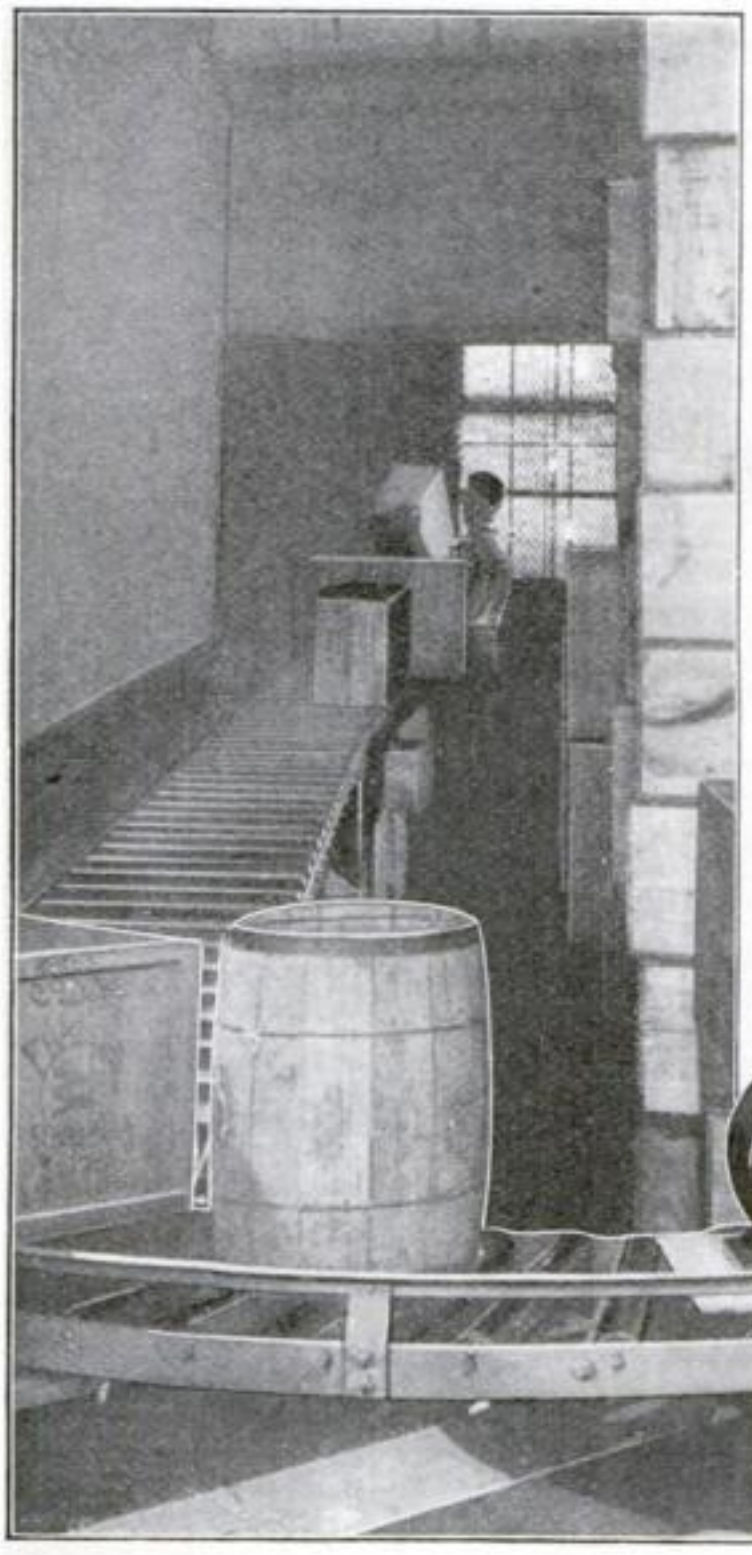
One of these gravity-conveyer systems is in operation in a Boston warehouse, where it transports goods of any regular shape from the third floor to an elevator on the second.

Corns—What They Are and Why They Hurt

CORNS, like corsets, boarding-houses and late hours, are a menace to one's sweet disposition.

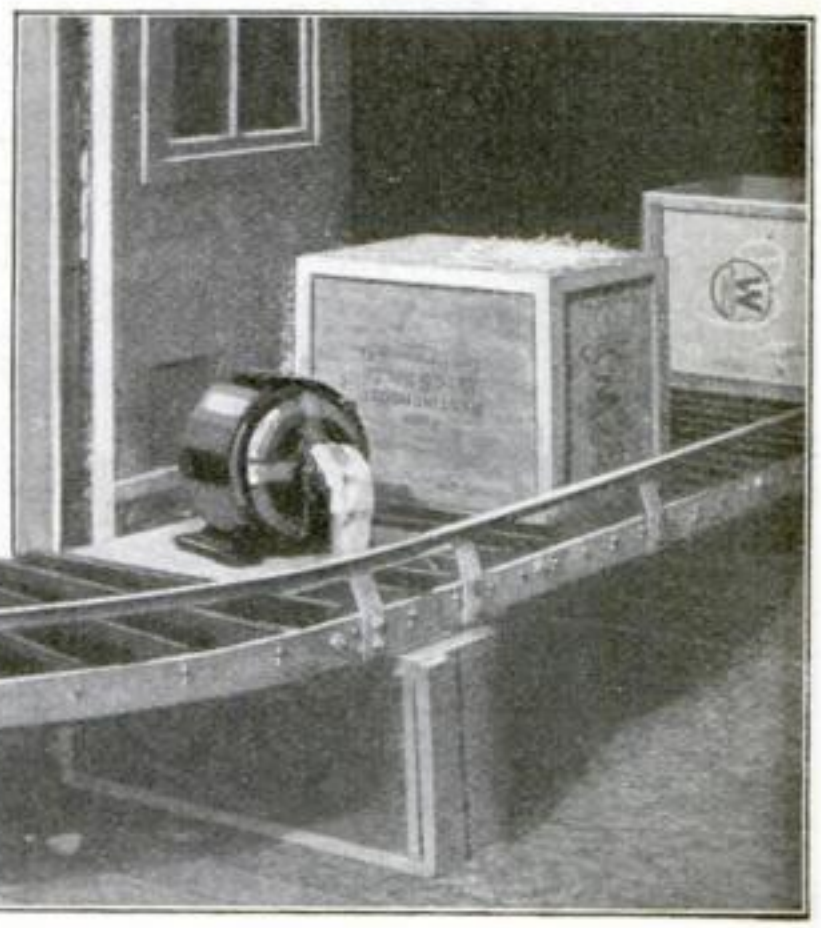
Corns are hard growths which occur on the toes or some other part of the feet. They are generally the result of wearing a shoe too small for the foot. They are thickenings of the outer layer of the skin in the center of which is a nail-like peg which projects downward and hurts when pressed upon. Soft corns form between the toes and are only different from others in that they are soaked with perspiration all the time. The corn itself is composed of a lump of the outer part of the skin which is caused by the pressure of the shoe at that spot. However, the corn would not result unless the pressure were taken off at intervals, and this, of course, is done when you take the shoe off. It stands to reason that if the pressure were continuously applied to this spot, the skin, instead of overgrowing at that precise point, would waste away. The overgrowth of the skin is due to the irritation produced by the pressure.

Shoes play an important part in the comfort of feet and consequently in contributing to the health and general happiness of the individual.



The gravity conveyer reverses the conditions of the bicycle traveling down a smooth road; it contains within itself the wheels

By means of curves, switches and other appliances the conveyers may be run around corners, partitions and over floors



Housekeeping Made Easy

Above: A gas-stove with five different ovens meets all possible baking requirements

At left: A kitchen drinking fountain attachment of the "bite the bubble" variety

Below: The soap won't slip into the water when this attachment is on the board

Below: A skirt-marker which is simply a chalked cord clamped to any convenient place

Below: A space-saving phonograph cabinet with a sliding top. To obtain a record the phonograph is slid to one side

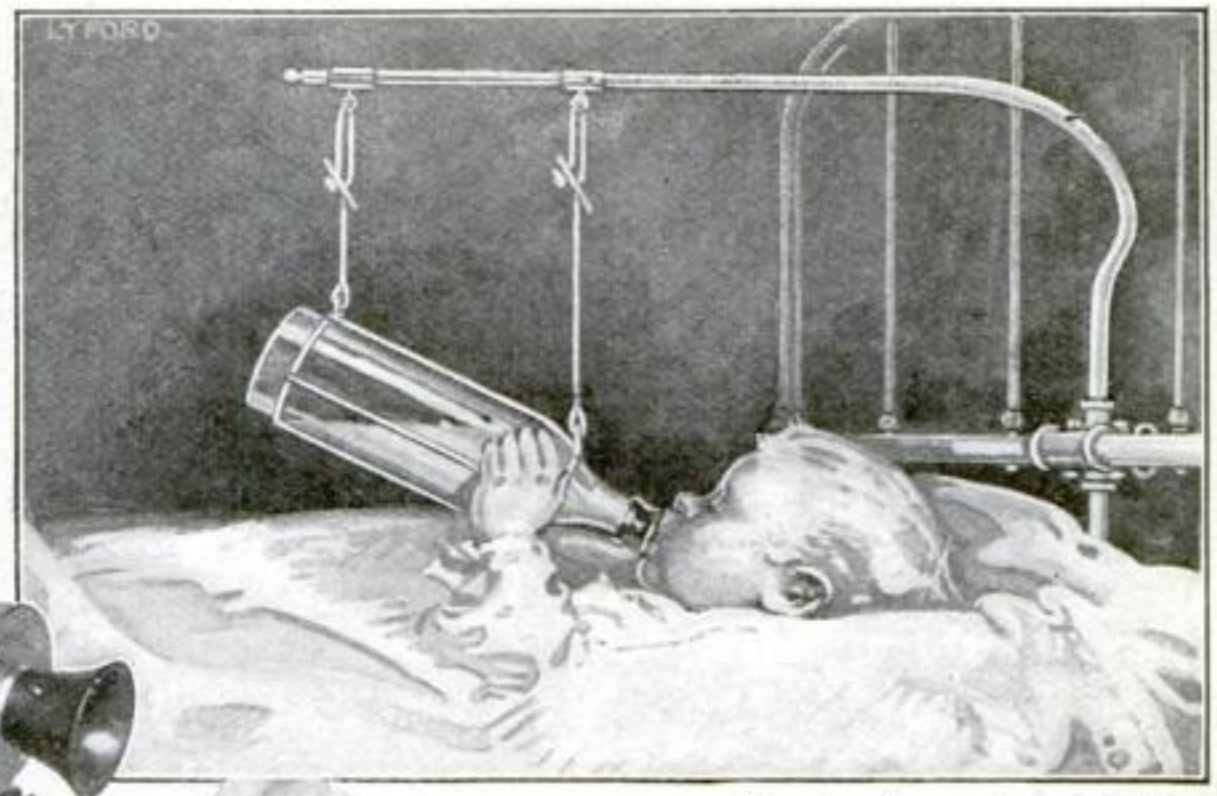
Above: A combined soap-carrier and massage device about the size of a small pocket comb

Housekeeping Made Easy

Above: A wrist-lock for handbags which prevents loss and leaves the hand free

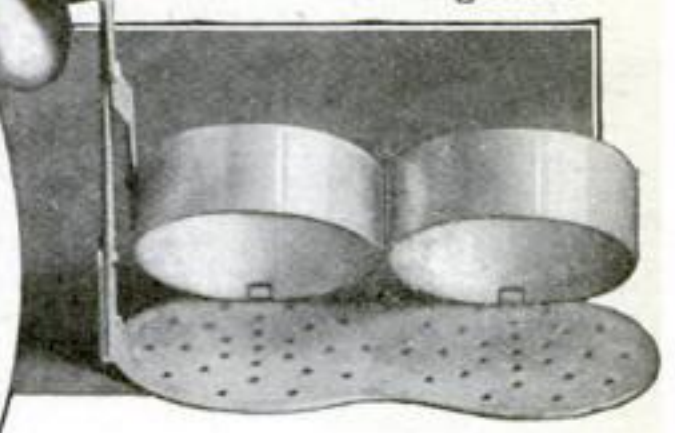
At right: A pencil holder attached to the telephone

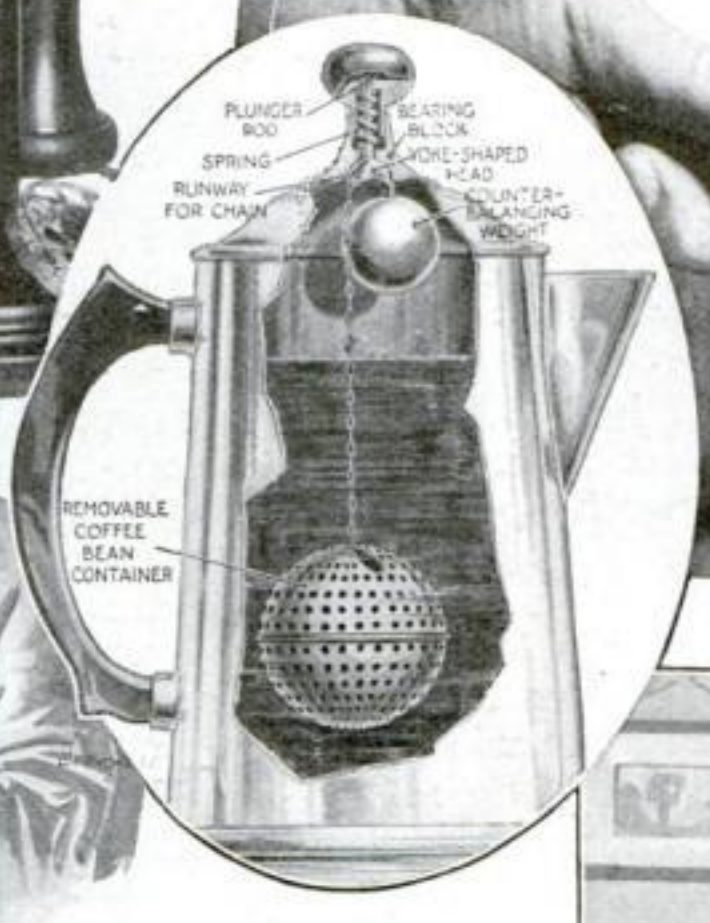
Below: A heating coil is in the bulb. By pressing the bulb, hot air is forced through the teeth of the comb to dry the hair



Above: A nursing bottle-holder which slides on a rod to any desired position

Below: An egg-poacher which, when tilted, deposits the cooked eggs in a receptacle without breaking them





Above: A coffee or teapot with a suspended container attached to the inside of the cover

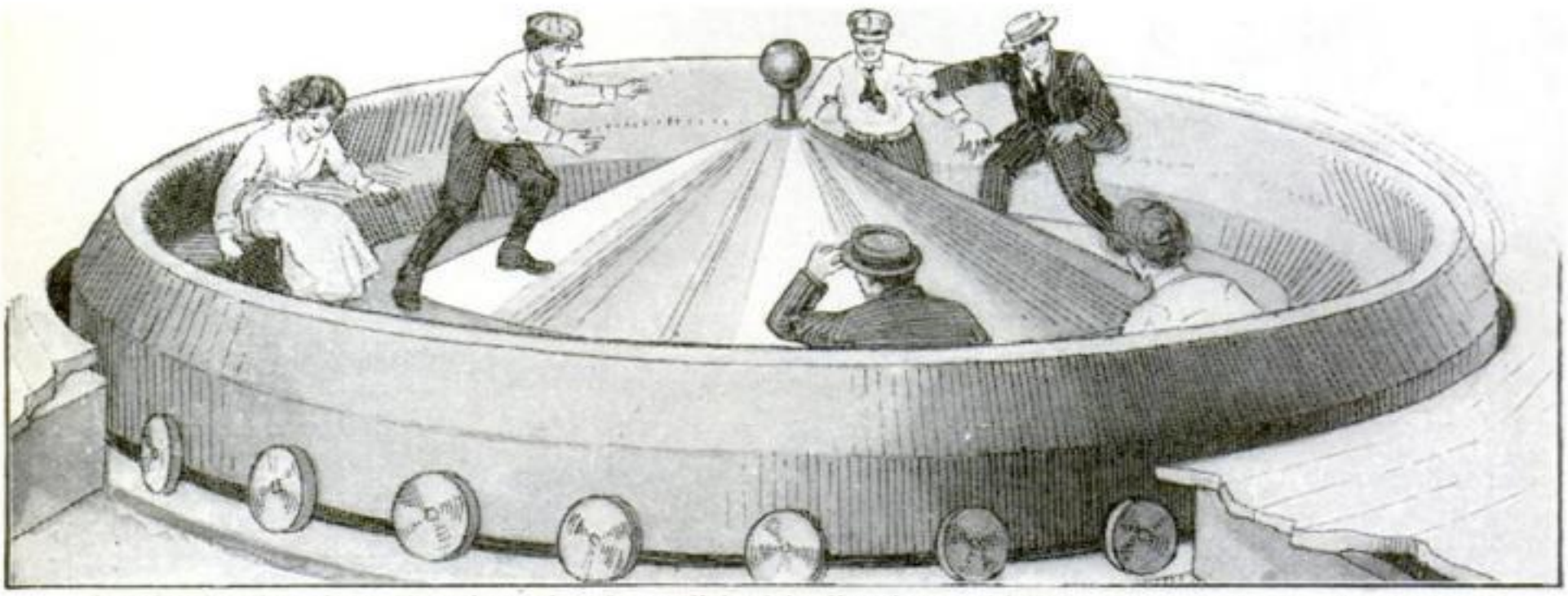
At left: A spring door-clip is slipped under the door and holds it fast

At right: A carpet beater which is operated by a crank handle connected with a spring

A Dozen Ways of Breaking Your Neck

Would you care to imitate the motion of a corkscrew pulling a stopper out of a bottle? Does the idea of looping-the-loop on roller skates thrill you? Would a dash under water in an open boat make life a little less wearisome? If not, this article will reveal more monotony killers

By George Wörts



A prize is placed on the pinnacle of a polished incline in a whirling wheel, but centrifugal force deposits the aspirants on the circular seat around the edge. The incline also revolves rapidly

THE suicidal instinct must lurk deep within us. In its mildest form it displays itself when we march up to a Coney Island neck-breaker and are twisted, turned and hurled by some fiendish contrivance. The barbarian treads keen knife-blades and up-ended nails when the need of self-pain possesses him. We, who are civilized, pay a dime to have our senses of gravity and equilibrium tortured and distorted. We drop down inclines with a speed sufficient to place the pits of our stomachs on an equal footing with our ears; we spin through halls of horror, built on the architectural plan of a Belasco hell, and we bounce and hop and skid over crazy contraptions in a way that would cause our Pilgrim Fathers to throw up their hands in holy terror. In spite of it all, we like it. Nine times out of ten, we lay another dime and dash into the Hall of Horrors for a second thrill.

Back in the days of our barbaric beginnings, when we were smitten with the pangs of self-hate and we had tired of treading hot coals or up-ended spikes or set-in safety razor-blades, we consulted the medicine man, and lo!—he contrived a new and refreshing torture.

Are you tired of such mediaeval tortures as the scenic railway with its stomach-elevating swoop? Do the crash and splatter of the shoot-the-chute bore you? Thumb, then, the illuminating pages of the Patent Office Gazette, and let the medicine-man inventor decide for you. Select your neck-breaker and request your favorite amusement park man to build one.

The Wastebasket of Dizziness

For example, there is a thriller which might be labeled "The Wastebasket of Dizziness" (page 862). Another good name for it is the "autowhirl." A wood or steel structure resembling a gigantic wastebasket is lined with rails set spirally. The car starts at the top, gathers momentum and whirls around and around until it shoots out at the bottom. It resembles the baskets of death so familiar to the circus or vaudeville *habitué*, in which a bicycle or motorcycle rider drives around and around until, by centrifugal force, he has attained a whirling motion parallel with the stage.

Exhibit B partakes of the merry-go-'round variety of thrill (page 862). A mountain stream which apparently defies the well-known law that water runs down hill, not up, cascades merrily up and down a narrow ravine. This feature is achieved through recourse to a good plumber. It surpasses Tennyson's brook. It not only flows on

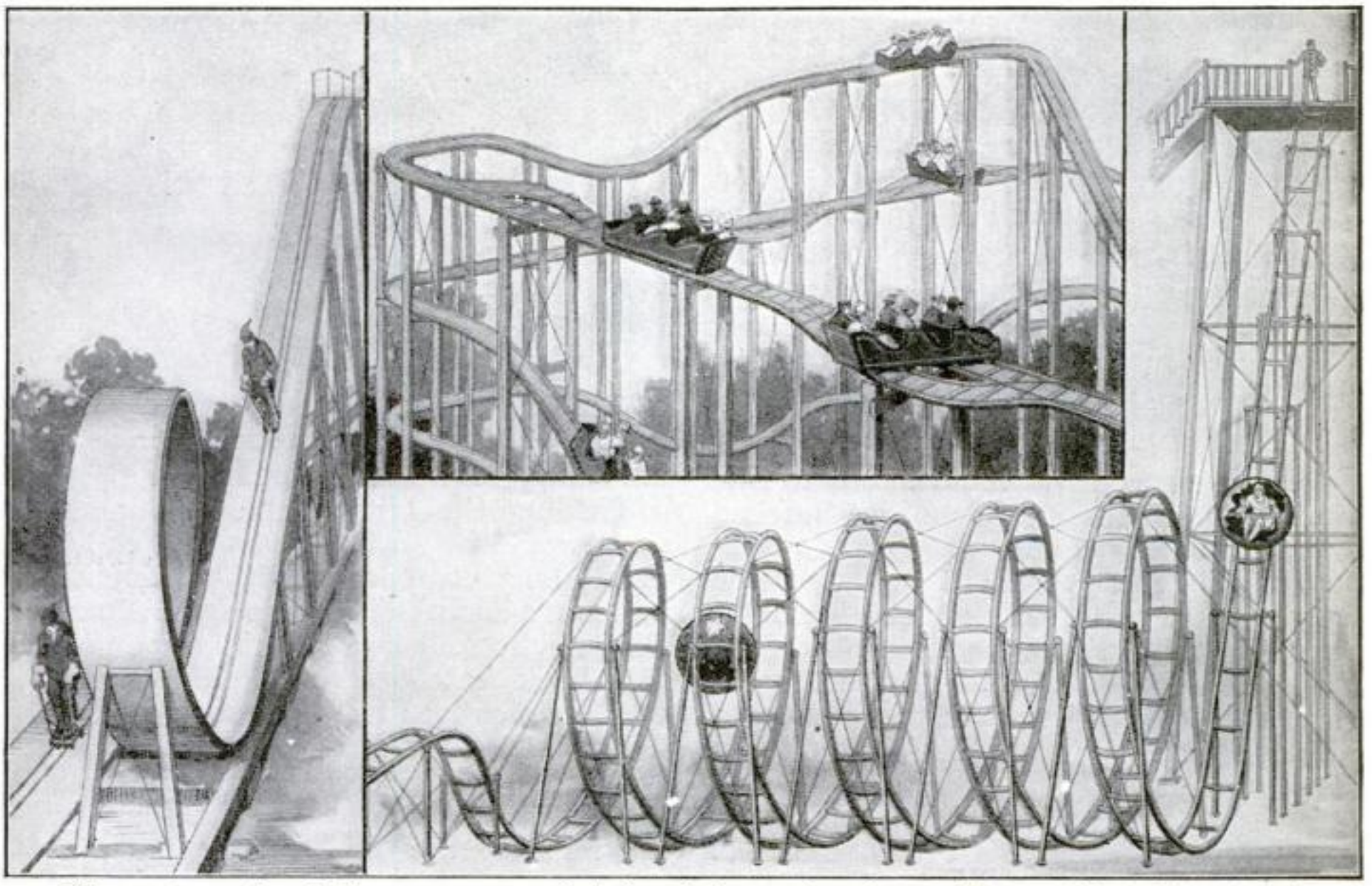
and on, but it meets itself; for it is circular. In the center of the circle a huge mast is pivoted. Six poles reach horizontally outward from the top, and at their tips cables are attached, which terminate below in the prows of six small boats. The mast revolves, and the boats are drawn on a monorail through the circular stream. To all intents and purposes this giant toy is the old merry-go-'round, well disguised by mountain scenery, with something of the scenic railway thrown in for good measure.

Tobogganning in Summer

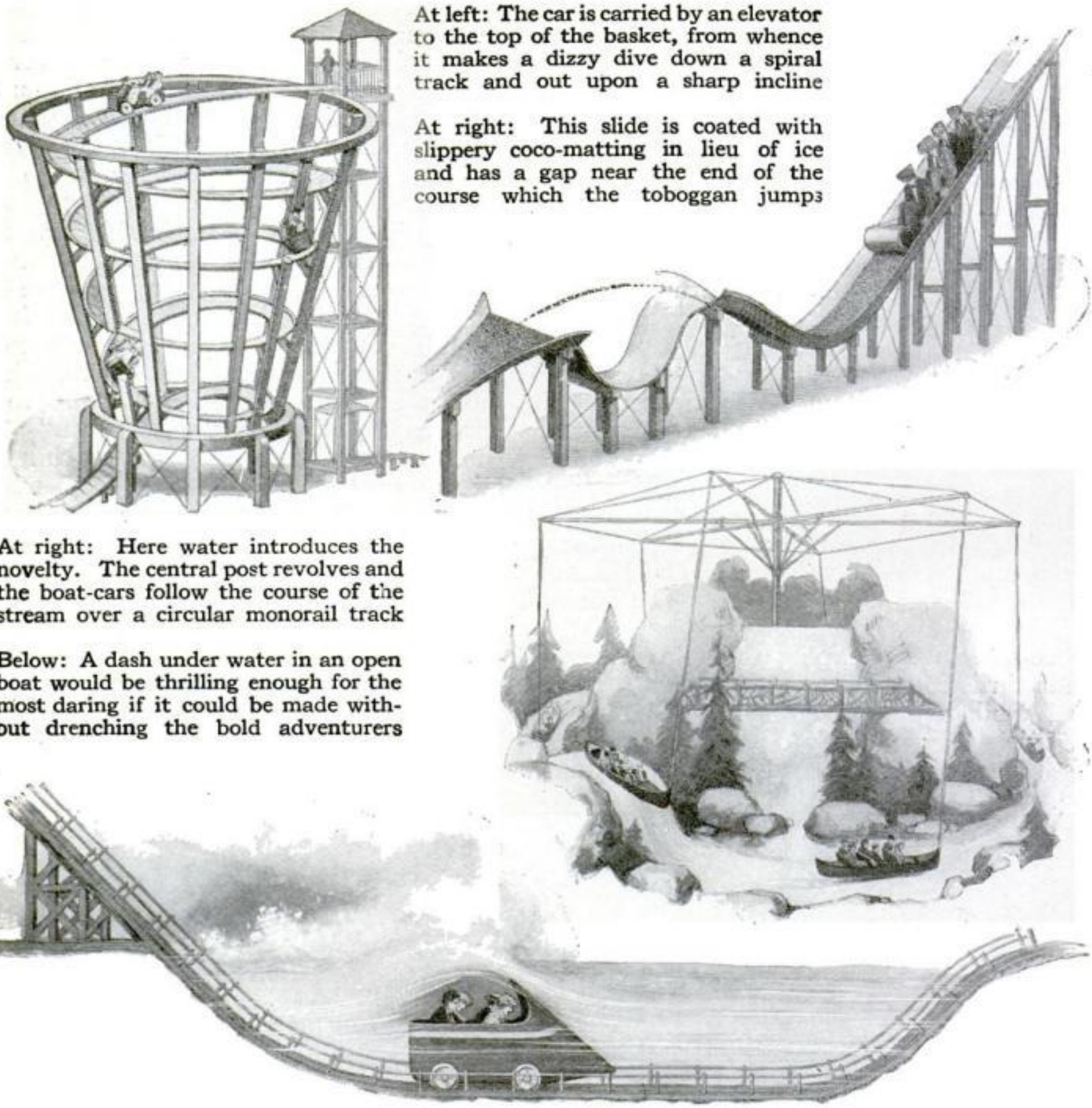
Perhaps the hardihood of the people of the ice countries inspired the genius who conceived the idea of the all-year-'round toboggan, which is shown on page 862. The Alpine slope is made of wood or structural steel and in place of a smooth ice surface, coco-matting is substituted. The bottom of the toboggan is polished metal, and it glides freely over the slippery nap of the coco-matting. Leaping the gap squeezes this thrill to its tenuous limit.

A Philadelphia inventor has found a way to inject a new thrill into the scenic railway (see below). Instead of continuing in a direct course up and down and around dizzy curves, the Philadelphian proposes to reverse the direction of the car at certain shocking intervals. One moment you are hurtling through space; the next, you are suddenly spun about and fly on in the same direction, but with your back to the scenery.

Only circus performers should be permitted to indulge in the neck-breaker shown at the right of the illustration on page 863. The thrill to the amusement seeker is derived from watching. Two large concentric rings of metal comprise the vehicle, which, following circus precedent, ought to be christened "The Ring of Death." The smaller ring revolves easily within the larger one because of small oiled wheels between the two. A saddle and handle are bolted to a brace on the inner ring. When the outer ring revolves, the man on the saddle is stationary. The rider in the hoop of death rolls down a protruding incline built from the top of a tower and drops through the air—leaps the gap, that is to say—and if the ring has not toppled in its flight, strikes the incline and coasts to safety while the spectators sigh in relief.



The most popular of all amusement-park devices is the scenic railway. The special thrill produced by the one shown above in the center occurs at the switches placed at intervals along the course, to whirl the car around suddenly. The device on the right is a hollow steel ball in which the occupant is hermetically sealed to whirl down an incline and over a spiral track. On the track on the left you may loop-the-loop on roller skates which cannot be pulled out of their grooves



At left: The car is carried by an elevator to the top of the basket, from whence it makes a dizzy dive down a spiral track and out upon a sharp incline

At right: This slide is coated with slippery coco-matting in lieu of ice and has a gap near the end of the course which the toboggan jumps

At right: Here water introduces the novelty. The central post revolves and the boat-cars follow the course of the stream over a circular monorail track

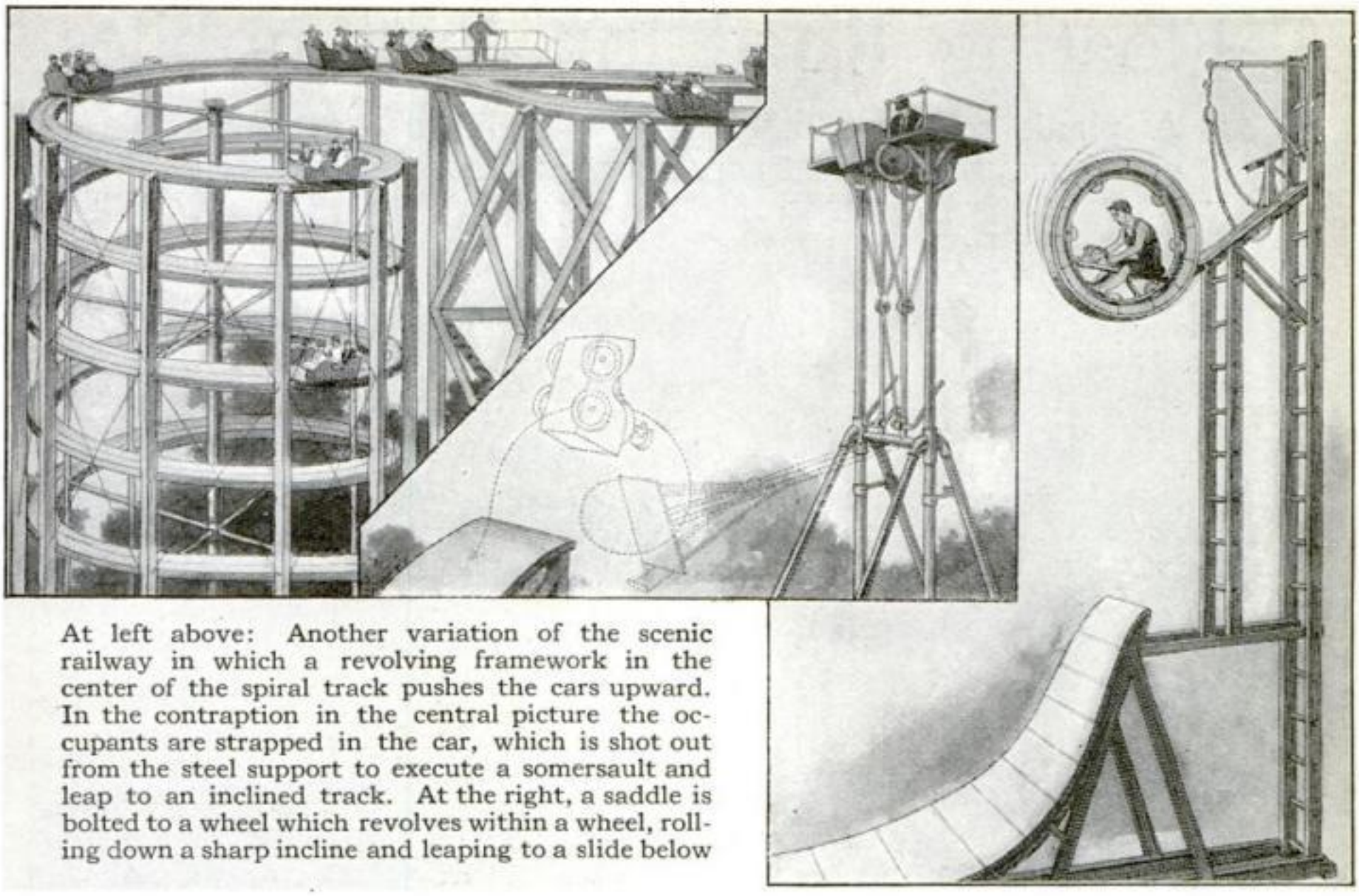
Below: A dash under water in an open boat would be thrilling enough for the most daring if it could be made without drenching the bold adventurers

Commend Yourself to the Angels When You Ride in This

All nerve specialists could afford to ride in expensive limousines if an idea hatched by a Belgian should have widespread reception. The patent claims describe the invention as an "amusement device." Called by any other name, it would centrifugally snap the head of any enemy to society from his shoulders with equal adroitness. The awful thing is shown in the central picture in the group of three on page 863. A car, of the loop-the-loop or scenic railway variety, is attached to the end of an upright steel pole which is pivoted to a steel frame of considerable height. The car revolves once, then is automatically detached from the pivoted pole; it flies through the air, describing a somersault unassisted, finally landing upright on an incline—provided that the angels in heaven are smiling and nothing goes wrong.

Tickling the hind heel of an irascible mule would be an intelligent and cautious proceeding compared with risking one's precious neck in this machine. The final incline might well be made to terminate in the back entrance of an undertaker's establishment, to facilitate delivery.

Aside from an occasional freak such as this, improvements upon or embellishments to the scenic railways of our childhood occupy the time of most amusement inventors. A helical track, not unlike the "Wastebasket of Dizziness" mentioned previously, is the most absorbing feature of another neck-breaker. The car ascends the spiral, and a loop-the-loop is inserted



At left above: Another variation of the scenic railway in which a revolving framework in the center of the spiral track pushes the cars upward. In the contraption in the central picture the occupants are strapped in the car, which is shot out from the steel support to execute a somersault and leap to an inclined track. At the right, a saddle is bolted to a wheel which revolves within a wheel, rolling down a sharp incline and leaping to a slide below

elsewhere in the track so that the mad occupants of the car will be sure of their money's worth.

Let us not forget the "Corkscrew of Fate," or whatever it may be called, which is illustrated on page 861. One enjoys the corkscrew motion after having entered a hollow steel ball and dropping in it down a precipitous incline. Centrifugal force holds the ball to the rails, and it whirls around and around in the spiral, rolling out at the end against a cushioned bumper, where the occupant emerges, a sadder and wiser, if not a broken, man.

The whirling wheels of Coney Island are reflected in a recent British patent device. Built as a horseless merry-go-'round, a revolving platform offers its occupants the pleasure of climbing a steep slope to the center and seizing a prize which is placed there. Centrifugal force explains why very few aspirants could reach the box of bon-bons, solid gold watch, bouquet of flowers, pint of gasoline, or whatever the prize might be.

Fortunately, serious-minded men in amusement-park communities have the power to censor the extent to which these thrills may be carried. Yet for each life-risking device which the censors have deleted a dozen others have been brought forth. The loop-the-loop devices are no longer popular, being too literally neck-breakers; but the amusement-park man who claims that he cannot find enough thrillers for his patrons is either lazy or lying.

The Medicinal and Hygienic Virtues of the Lemon

IF the testimony of the Sicilian Citrus Chamber is given due consideration in determining the status of a lemon, it deserves an important place in the list of first aids. According to the authority mentioned the lemon aids are chiefly medicinal and hygienic. Its juice is of value in treating diphtheria and gout. For ordinary colds it is a great specific. It will cure slight wounds and chilblains. The juice of several lemons taken every day will help to cure rheumatism and prove an antidote for diabetes; small slices applied to corns will ease the pain.

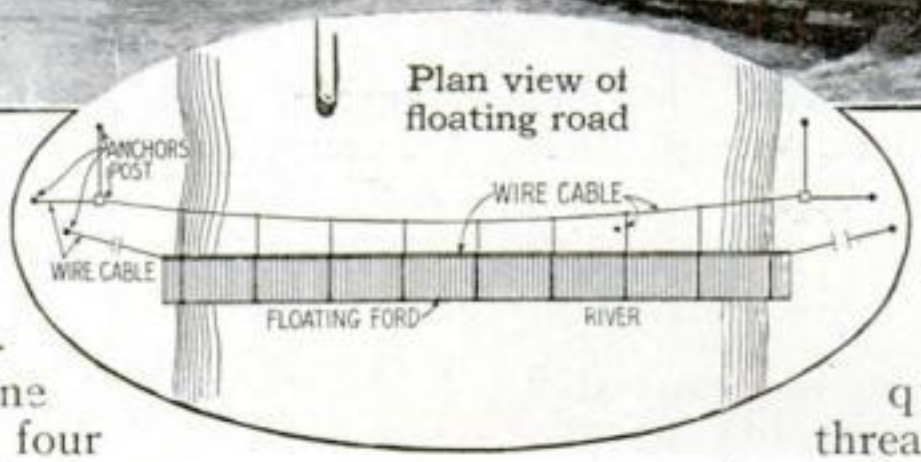
As a cleansing agent and beautifier, the reputation of the lemon soars still higher. The juice whitens the hands, improves the complexion, helps, if anything can, to remove freckles. In the culinary department it ranks with salt and sugar in general usefulness, and as a furniture polish its oil is beyond reproach.

And yet to be dubbed "a lemon" is considered uncomplimentary!

A Floating Road for Automobiles

A plank roadway built over a California stream enables automobiles to cross under their own power

Above: Light cars pass over the semi-floating bridge at a speed of about ten miles an hour



At left: The bridge plans. The supporting cable was twenty-five feet above the plank sections

A SEMI-FLOATING bridge, one hundred and four feet in length, has been constructed by the California Highway Commission over Castaic Creek on the recently opened Los Angeles to Bakersfield route. The ford at this point has long been a menace to automobile travel, because of the varying depth of water and the extremely sandy bottom. Teams have, therefore, been maintained at the crossing by the county to tow automobiles across. While effective, this method was very unsatisfactory.

To relieve this condition a semi-floating highway bridge was constructed. A plank road was built in sections and held together by cables in such a way that a good surface would be continuous across the ford. The depth of the water was thus decreased, not only by the thickness of the plank and stringers, but also by the amount which the tires would otherwise sink into the soft, sandy bottom.

After the sections were built on shore and floated to the crossing, they were held together by a three-quarter-inch cable threaded through eyebolts in each section. At twelve-foot intervals the cable was attached by one-half-inch cables to a seven-eighth-inch cable stretched across twenty-five feet above the plank sections, and drawn sufficiently taut to support it four feet above high water.

One end of the bridge was securely anchored with a three quarter-inch cable clamped to the eyebolt on the last twelve-foot section, and made fast to the shore. The opposite end was lightly secured with a one-half-inch cable to the shore. This was done so that in case of high water carrying drift against the bridge, one end would be released from its anchoring point, allowing the bridge to swing around to the opposite bank.

The bridge was completed in two days at a cost of $17.50 for labor and $126 for material, freight and cartage. Light cars can pass over it at a speed of about ten miles an hour without submerging the different sections as they pass over.

Faster Than the Fastest Express Train

The new Curtiss biplane makes one hundred and nineteen miles an hour

By Carl Dienstbach

On account of its moderate size and its elimination of small exposed parts this biplane has speed and climbing power

THE really formidable problem of the aeroplane of to-day is cutting down the resistance of its structure.

A very meritorious solution of this problem is found in a new Curtiss biplane which has attained speed and climbing power way beyond the usual range of its allotted motor power. The accompanying picture reveals its points of difference. Raking the air by small parts is eliminated more than in any previous design. The new machine shows "smooth bulk" and properly shaped "streamline" (to use a hackneyed and often unjustified expression) from the spokeless wheels and their triangular-shaped "legs." An important exception are the few struts which as triangular frames join the upper plane at its center to the body. There is only one bracing member on each side. This is a bulky strut running from the lower to the higher plane and inclined so as to be compression and tension member in one. Additional bracing is supplied by a similar but even more inclined strut running to the wheel-base. Hence the biplane is stayed like a monoplane, and the design becomes very strong.

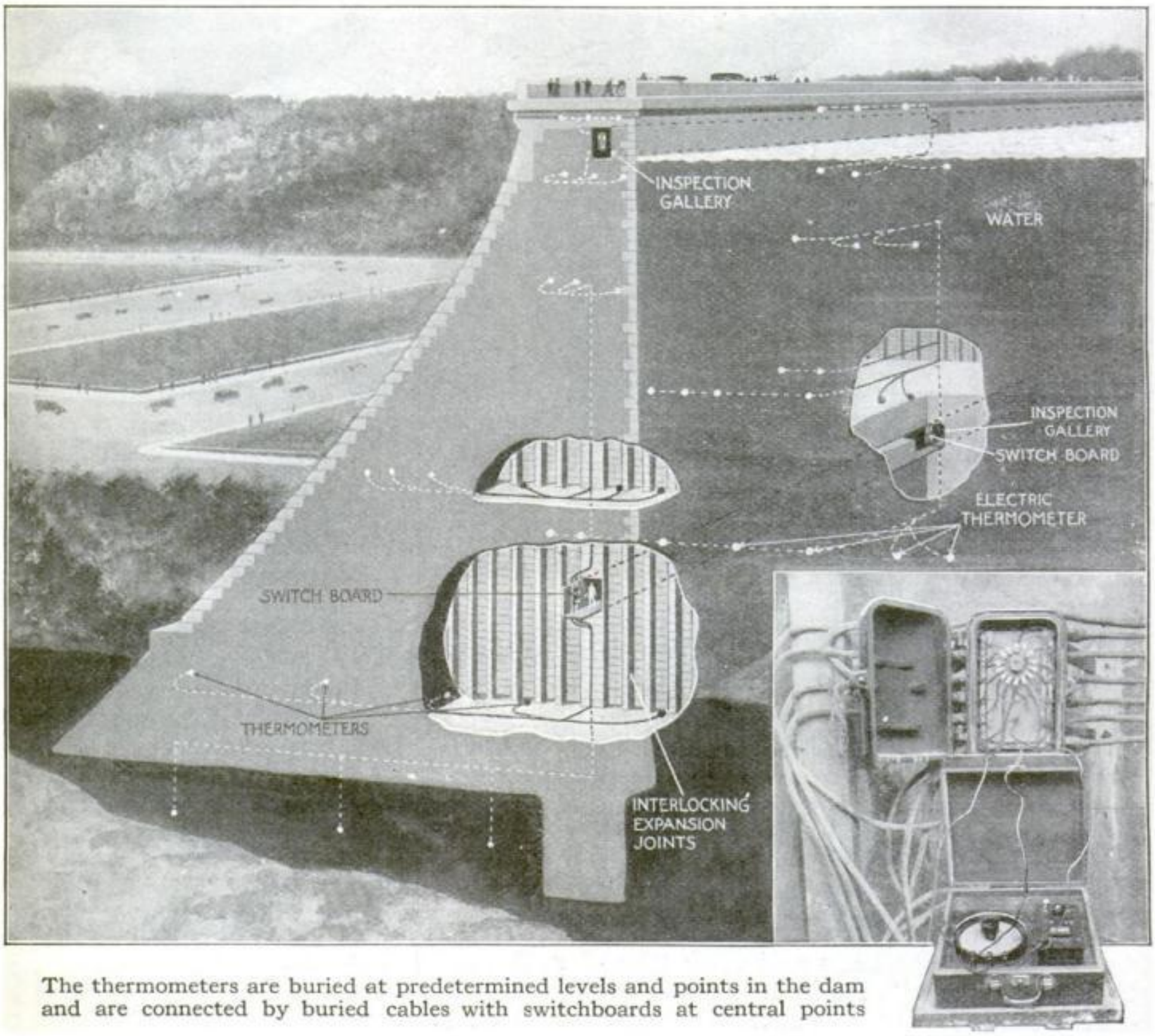
As the wheeled base must in any case form a strong downward projection, it should be made thus to serve as a support for the wings and be thereby braced in turn against side strains in bad landings. All vibrating wires may be eliminated in this way, and hence an immense amount of head resistance. The new bulky bracing members do not vibrate. Their number and smooth shape permit the air to flow off easily on all sides without being caught by many adjoining wires and other exposed details, as by a rake. The flaring of the main braces at their ends is necessary to distribute their support over the depth of the ribs. There is one more improvement. A circular hood which revolves with the propeller is placed in front of the radiator. It is open so as to draw in cooling air, but is so designed as to cut down resistance.

The machine offers a very satisfactory solution of the "unsurmountable" problem of carrying much sorely needed wing-surface on an extremely fast racing machine. Former "racers" were the poorest climbers and very dangerous in starting and landing on account of dependence on unduly reduced wing-area for speed. But the new Curtiss racer is useful all around. Its splendid performance—one hundred and nineteen miles an hour—is entirely due to its moderate size. Large machines, on account of inherent relative weakness, are hopelessly dependent on wirebracing.

Taking the Temperature of a Dam

Forty-seven thermometers are buried in the concrete of the Kensico dam

By Herbert Francis Sherwood



The thermometers are buried at predetermined levels and points in the dam and are connected by buried cables with switchboards at central points

ONE day, a year ago, I paid my first visit to the great Kensico dam, three miles north of White Plains, N. Y., counted among the notable dams of the world. It is intended to form a storage reservoir in the Catskill system of water supply which New York city is constructing at an expenditure of $177,000,000. The lake of Catskill water behind it will be approximately four and a half miles in length. It will have a maximum depth of one hundred and fifty-five feet, and contain upwards of thirty billion gallons of water.

It was a bleak day. The thermometer early in the morning had registered zero. A searching northwest wind swept down through the whole length of the great basin in the Bronx valley and chilled to the marrow those who went out upon the crest of the dam. Accompanied by the division engineer, I descended from this exposed place to the long corridor extending for more than a third of a mile through the dam. This corridor was open to the sky at intervals and I was astonished at the warmth of the air encountered there.

"This part of the dam has only recently been laid," said the engineer, "and the heat, generated chemically by the cement in the concrete as it solidified, has not passed off yet."

Then he explained that concrete expands and contracts, after the fashion of steel, and that the dam had been built in sections about seventy-nine feet long, interlocking from the bottom to the top. Observation of other Cyclopean structures of masonry had revealed the fact that in the course of expansion and contraction cracks appeared about seventy-nine feet apart. So it had been decided to provide in this way for expansion-joints in the dam.

As little was known of the changes of temperature which occurred in a large mass of concrete and as this information might be of value in designing other structures of similar character, it was determined when the Kensico dam was built that its temperature should be taken regularly at different points between the base which is one hundred and fifty feet below the surface of the ground and the top, approximately the same distance above it. This has now been done for a period of more than two years, an electric thermometer being used for the purpose.

A thermophone is a device which will measure by means of an electric circuit the temperature at any point connected with it by wires. Its principle is that of the well-known Wheatstone bridge by which resistances can be measured. The cable which leads from the recording apparatus and the dry batteries to the sensitive resistance coils where the temperature is to be taken carries three insulated wires. Through one of them the current passes to the sensitive terminal, where it is divided and returned through two minute coils of copper and German silver wire. These metals are affected differently by changes in temperature. These changes affect differently the freedom with which a current of electricity will pass through them, and this difference indicate what the temperature is.

Forty-seven thermometers were buried in the dam, the lowest being below the foundation. They were connected with switchboards placed at central points, the cables, carefully protected, being buried in the masonry as it rose. There are three switchboards, the lowest being stationed in a nook in the long inspection-gallery.

Will the Great Sphinx Scowl When She Sees This?

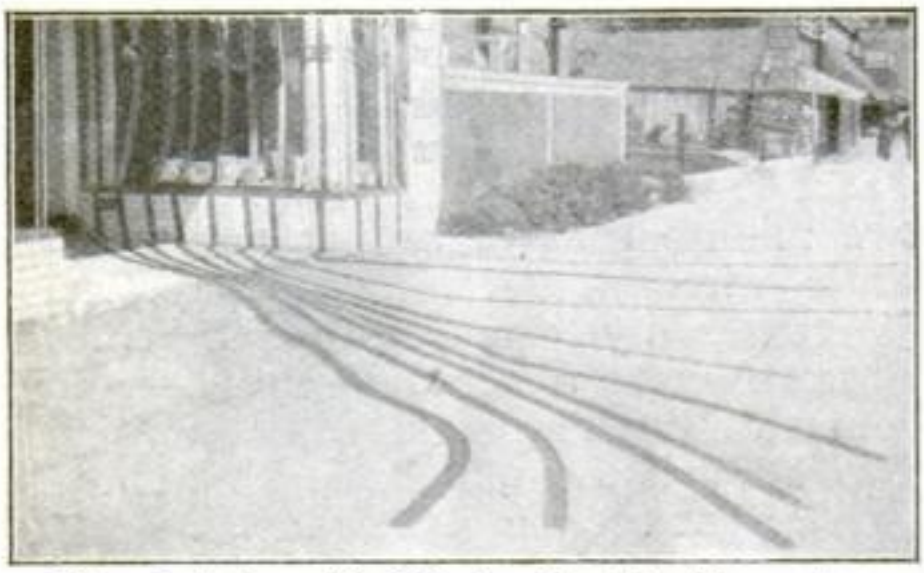
IN seeing America first one should not overlook the Sphinx built at Blue Point, Long Island, by William Graham. This domestic Sphinx is just one seventh the size of the original great Sphinx in Egypt, and it is just as mute. It weighs forty-two tons.

The idea of decorating his front yard with a copy of Egypt's great attraction came to Mr. Graham when he was removing a large quantity of sand from his lawn. Instead of carting the sand away, as he had done in past years, he collected it in a huge pile, and then drew up plans for his Sphinx. The sand was mixed with concrete and iron scrap.

The head of the Sphinx weighs ten tons. The lower part of the image is a room with an opening at the rear

The head of Mr. Graham's Sphinx is solid, weighing ten tons. The lower part of the image has a circular chamber with an opening at the rear. Seats and pillars of concrete extend around its inner walls.

Laying a Brilliant Trail for Bargain Hunters



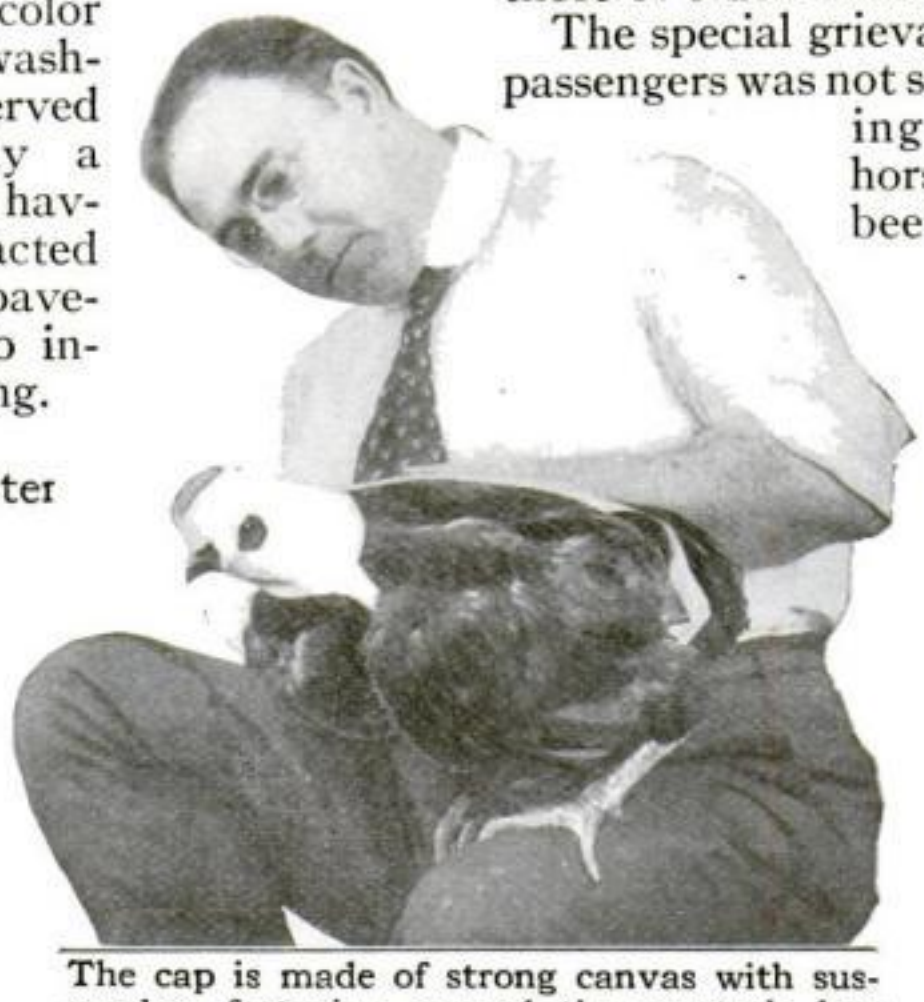
Broad stripes of brilliant red painted in water-color on the cement sidewalk converge at the show window and point out bargains

A CLEVER Los Angeles shop-dealer drew many passers-by to his show-window by a simple device which cost him only a few cents and a few minutes' work. He utilized the cement sidewalk in front of his store as part of his advertising medium, painting broad stripes of brilliant red on the pavement and spreading them out in all directions. They all converged, however, upon the show-window.

The scarlet stripes were carried up on the plate-glass, and behind the pane each stripe was continued further by a strip of red paper which led to some article in the window marked at a bargain price. The paint used was water color and could be readily washed off when it had served its purpose. Hardly a person passed without having the attention attracted by the lines on the pavement and stopping to investigate their meaning.

Separating the Rooster from His Crow

THE latest fashion news from the poultry yard describes a new style of nightcap for the rooster. Of course the rooster is not consulted as to whether he likes it or not, but he wears it under the mandate of the poultryman, who in turn is influenced by the more or less caustic remarks of his neighbors. For while wearing the nightcap the rooster is separated from his crow. No longer can he perform his natural duty of signaling to the immediate poultry population.



The cap is made of strong canvas with suspenders fastening around the rooster's legs

The cap is made of strong canvas and has suspender straps which fasten around the legs and hold the cap in place. These hang comfortably loose when the rooster's head is down, as when he is eating; but when he attempts to throw his head back and his chest out in order to give vent to his pride in a crow that may be heard by every rival cock for miles around, he finds himself unreasonably restricted. The cap muzzle may be worn during the day, also, if necessary.

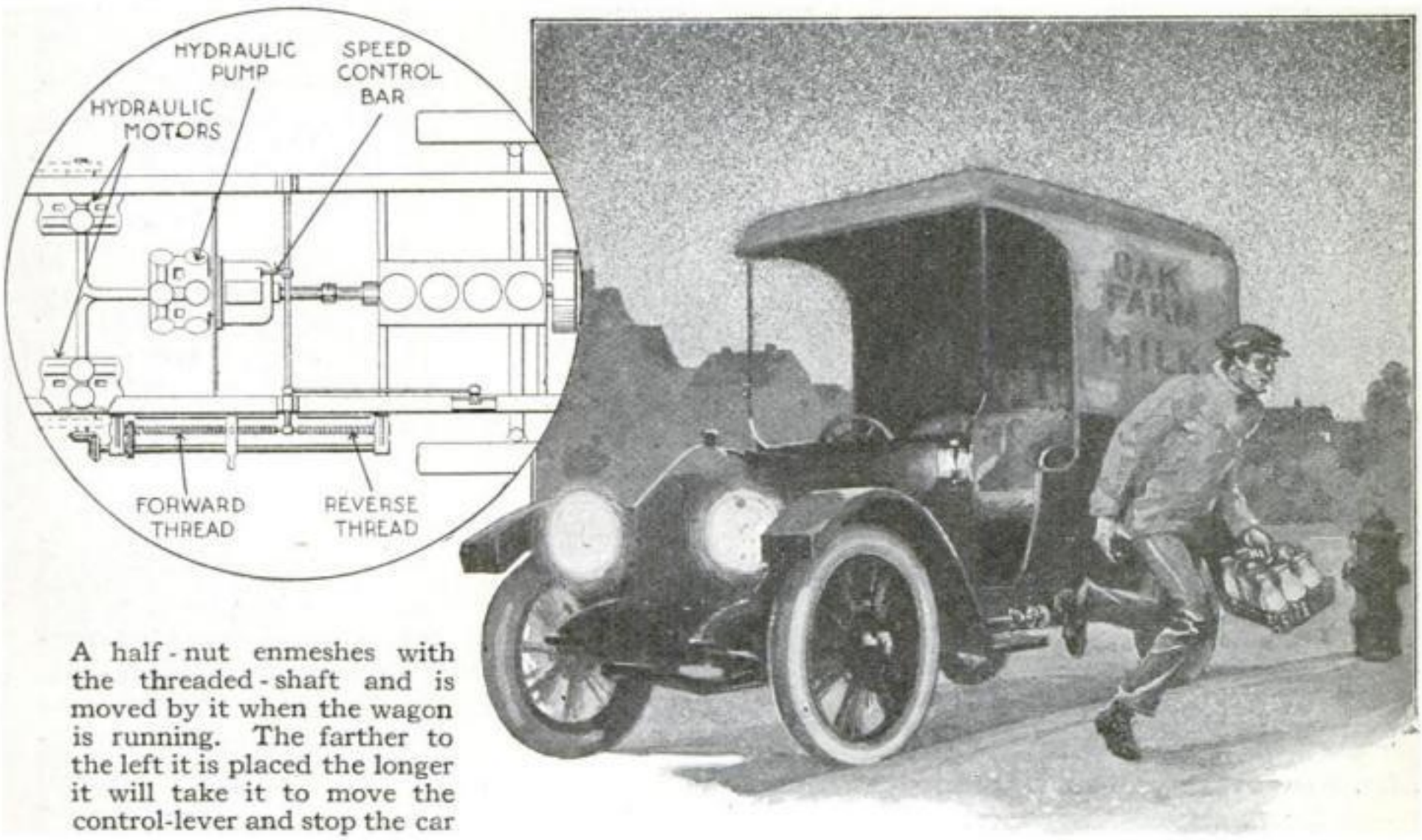
The "Step Lively, Please!" of Stage-Coach Times

WHEN the traveler's blood is boiling with resentment against the autocrats in uniform who issue peremptory commands and hustle belated passengers with scant courtesy into overcrowded cars, he is apt to inveigh against modern times and sigh for the days in which, although travel was slow, a man had at least time to catch his breath. But F. G. Marchand, a Canadian writer, in a graphic description of a stage-coach journey in the seventeenth century, shows that although conditions may change, the conductors of to-day and those of olden times are of one clan.

The special grievance of the stage-coach passengers was not so much the overcrowding, although the wooden horse of Troy could not have been more closely packed. It was the heartlessness of the conductor at the times and places allotted for eating, that finally caused a general strike of the patrons. He was accused of being in connivance with the inn-keepers, who invariably had a tempting *table d'hôte* ready on the arrival of the coach. But scarcely had the hungry travelers attacked the first course when "All aboard!" was shouted. The driver mounted his seat, cracked his whip, and the passengers either scrambled ignominiously aboard or were left behind.

The Intelligent Motor Milk-Wagon

Like the milkman's trained horse it ambles mechanically on while deliveries are made from door to door



A half-nut enmeshes with the threaded-shaft and is moved by it when the wagon is running. The farther to the left it is placed the longer it will take it to move the control-lever and stop the car

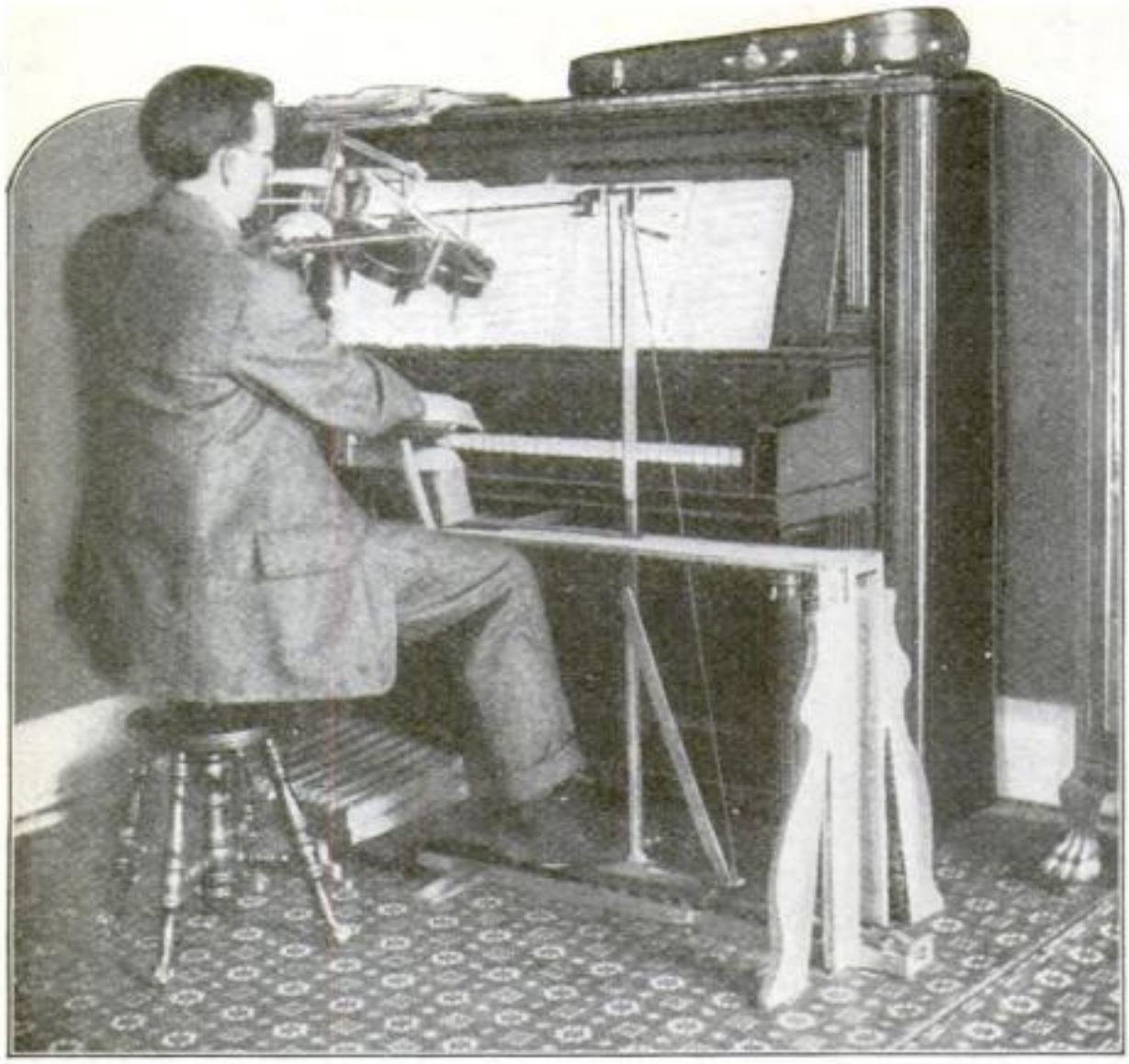
AT LAST the intelligence of a milkman's or baker's horse in moving from house to house during deliveries has been duplicated by a device applicable to any type of motor vehicle. It consists of a mechanism which may be set to bring the vehicle automatically to a stop at any desired distance from its position.

The operator of a truck fitted with the new device may fill his crate with enough loaves of bread or bottles of milk to supply a block or row of houses and set the control mechanism to run the truck to the end of the row while he goes from house to house.

The mechanism, the work of C. M. Manly, the inventor of the Manly hydraulic drive for motor-trucks, is shown in the accompanying sketches applied to a vehicle with that type of drive, although by suitable attachment to the clutch and brake-operating pedals it may be fitted to trucks with ordinary spur-gear transmissions that have shifting control members.

The device consists of two parallel shafts mounted on brackets on one side of the truck frame, forward of the jackshaft, as shown in the accompanying illustration. The outer of the two shafts, driven by means of a bevel-gear at its rear, which meshes with another on the extreme end of the jackshaft, drives the inner shaft through a pair of spur-gears. The outer shaft carries loosely a half-nut, the threaded portions of which engage the threads on the inner shaft. The nut can also be disengaged from the shafts and stored away when the driver is running the car from the seat. In its course along the threaded portions of the inner shaft the half-nut comes into contact with a vertical arm of the vehicle which is connected with the speed-control bar attached to the hydraulic pump through a shaft crosswise.

In operation, the driver sets the half-nut on the rearmost of the threaded portions of the inner shaft, according to graduations marked on the outer shaft. He then moves the vertical hand-control lever forward a short distance to start the truck at slow speed. Then as the vehicle moves forward, the inner shaft is revolved and with it the half-nut is moved forward until it comes in contact with the control-lever, at which time the nut moves this vertical lever on the crosswise control-shaft to its middle position, and causes the vehicle to stop.



Mayor Harry L. Suter playing the violin and the piano at the same time and making satisfactory music, at that

The Mayor of Moscow, Ohio, Is the Town's One-Man Orchestra

IN addition to directing the political destiny of Moscow, Ohio, Mayor Harry L. Suter is the town's one-man orchestra. He has devised an apparatus which makes it possible for him to play the piano and violin simultaneously. It takes both of Mayor Suter's hands, as well as his elbows, feet, and eyes to keep the two instruments going in the same musical time, but the results are worthy of his efforts, when one considers that he is an orchestra all by himself.

When the two instruments are under the spell of the Mayor, the right hand plays the solo part while the bass part of the piano is operated by the left foot coming in contact with a series of pedals similar to those of an organ. The violin bow is held on a small standard which moves along a groove. A double vise holds the violin, and the part through which Mayor Suter passes his left arm controls the violin, so that the proper string will rest against the bow. The bow is controlled by the right foot, while the fingers of the left hand press the strings. The elbow operates the "loud pedal.

Air-Jet Supports a Football in Mid-Air

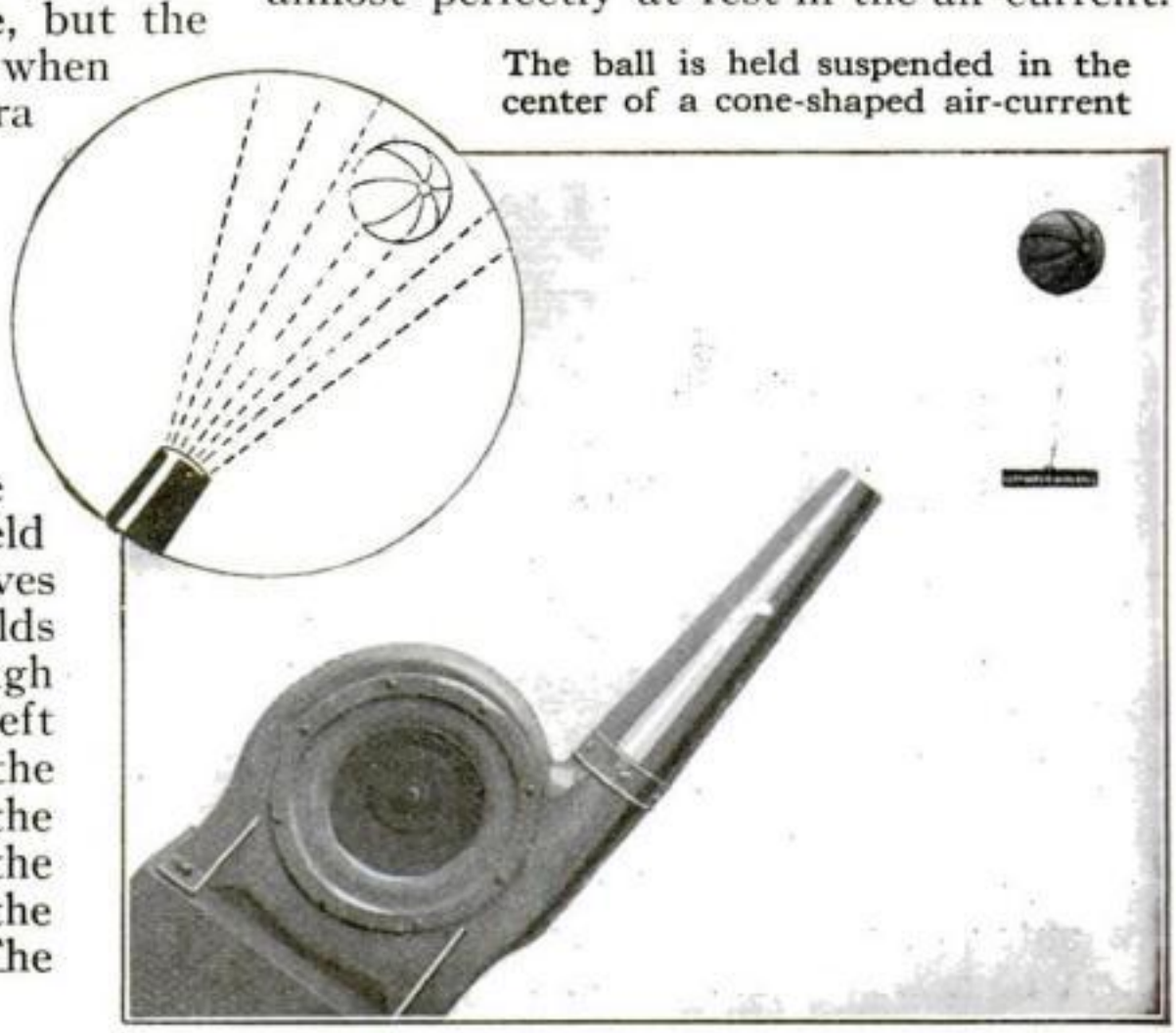
THE photograph below shows a football suspended in mid-air by an air-jet having a velocity of one hundred and twenty miles an hour. Suspended below the football, and attached to it by light wires is a plate which by its pull offers still further resistance to the air current.

This exhibition of the supporting power of an air-jet was given in Agricultural Hall, London, and the fan used was an ordinary centrifugal high-pressure blower with a six-inch diameter outlet at the extreme end of the nozzle.

The phenomenon is explained in the following manner: The jet issuing from the nozzle spread out into a cone-shaped formation on being released, and the ball was held in the center of this cone. The high-pressure jet acting upon the surface of the ball, caused a slight upward reaction which tended to maintain the ball in the air.

It will be seen that the ball is in the center of the jet and not on the edge of it. This is in contradistinction to the theory that the object is suspended by contact with the outer strata of air in the jet. The ball is held almost perfectly at rest in the air-current.

The ball is held suspended in the center of a cone-shaped air-current



How Man's Eyes Differ from Those of the Animals

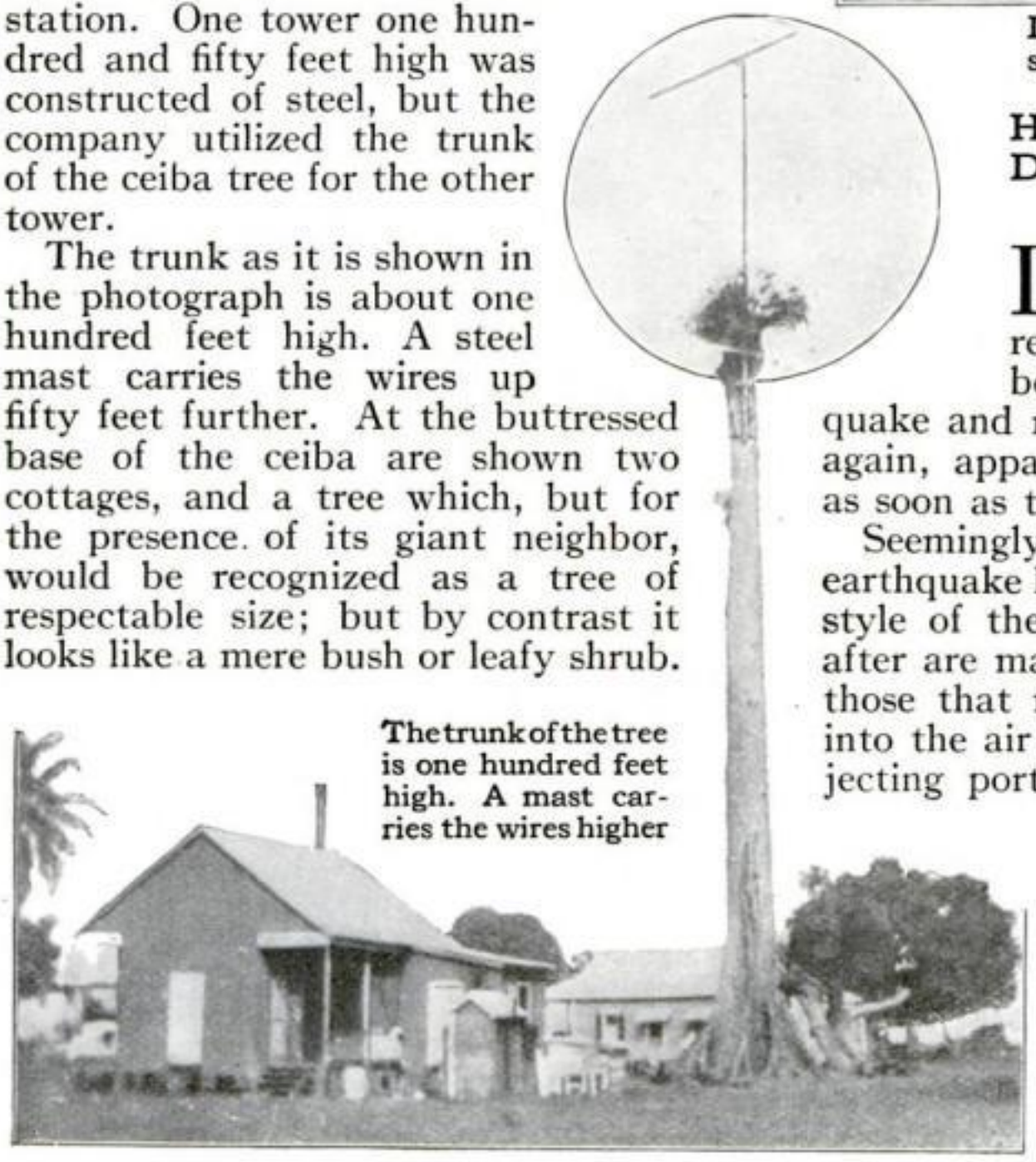
ASIDE from the monkey, man is the only animal having what we call binocular single vision. . That is, he can tell not only the direction of an object, but he can estimate fairly accurately its distance. This is because both of his eyes point at the same object at the same time, like two range finders. Other animals do not concentrate their gaze in this way. Their eyes are set more nearly at the sides of the head so that they see not only forward but backward for a short distance. Man, on the contrary, sees clearly only the object at which he looks directly.

Using a Tree as a Mast for a Wireless Station

THE ceiba tree is the largest specimen of the vegetable kingdom growing in Central America. The city of La Ceiba, chief among the settlements on the Caribbean coast of Central America, was given its name because a huge ceiba tree standing near the beach was a landmark for mariners.

Another of these huge trees was made use of when the big fruit company operating at La Ceiba built its wireless station. One tower one hundred and fifty feet high was constructed of steel, but the company utilized the trunk of the ceiba tree for the other tower.

The trunk as it is shown in the photograph is about one hundred feet high. A steel mast carries the wires up fifty feet further. At the buttressed base of the ceiba are shown two cottages, and a tree which, but for the presence of its giant neighbor, would be recognized as a tree of respectable size; but by contrast it looks like a mere bush or leafy shrub.



The trunk of the tree is one hundred feet high. A mast carries the wires higher

During an earthquake masonry is shaken off like dust from steeples

How Earthquakes and Similar Disturbances Change the Styles in Architecture

IT has always been a matter of conjecture why people will return to a locality which has been demolished by an earthquake and rebuild the city time and time again, apparently forgetting the disaster as soon as the debris is cleared away.

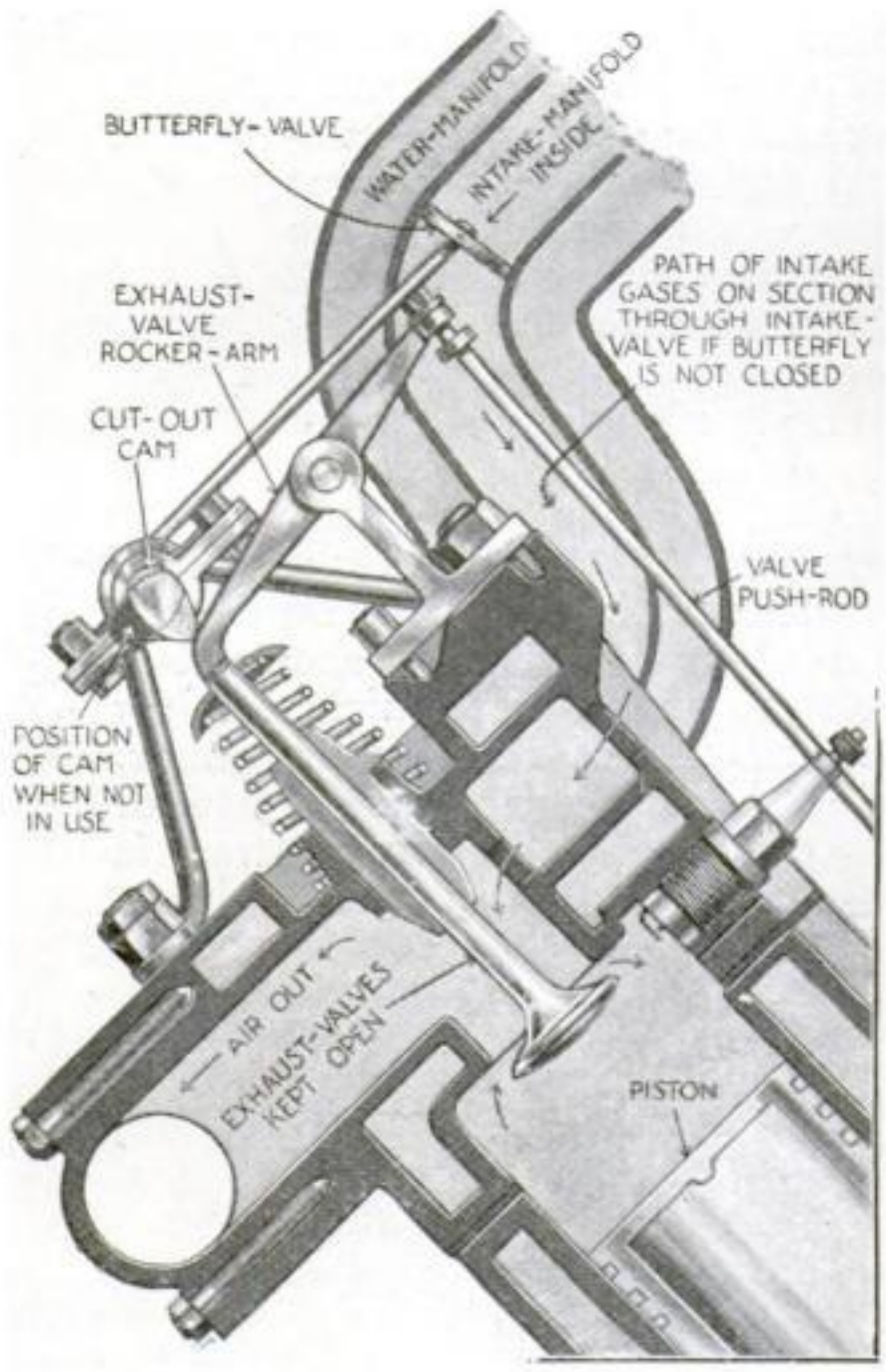
Seemingly the principal effect that an earthquake has on a region is to change the style of the architecture. Houses thereafter are made more squat and solid, and those that must have portions extending into the air reduce the weight of the projecting portions to a minimum. In the accompanying illustration, which is a photograph taken in Fort de France, Martinique, the church spire looks as though it had been left unfinished; but such is not the case. Its openwork construction is the approved style for steeples there.

Twelve Cylinders or Six in One Car

The transformation from a twelve to a six-cylinder automobile is accomplished simply by turning a lever carried under the steering-wheel. This cuts out the left-hand block of six cylinders

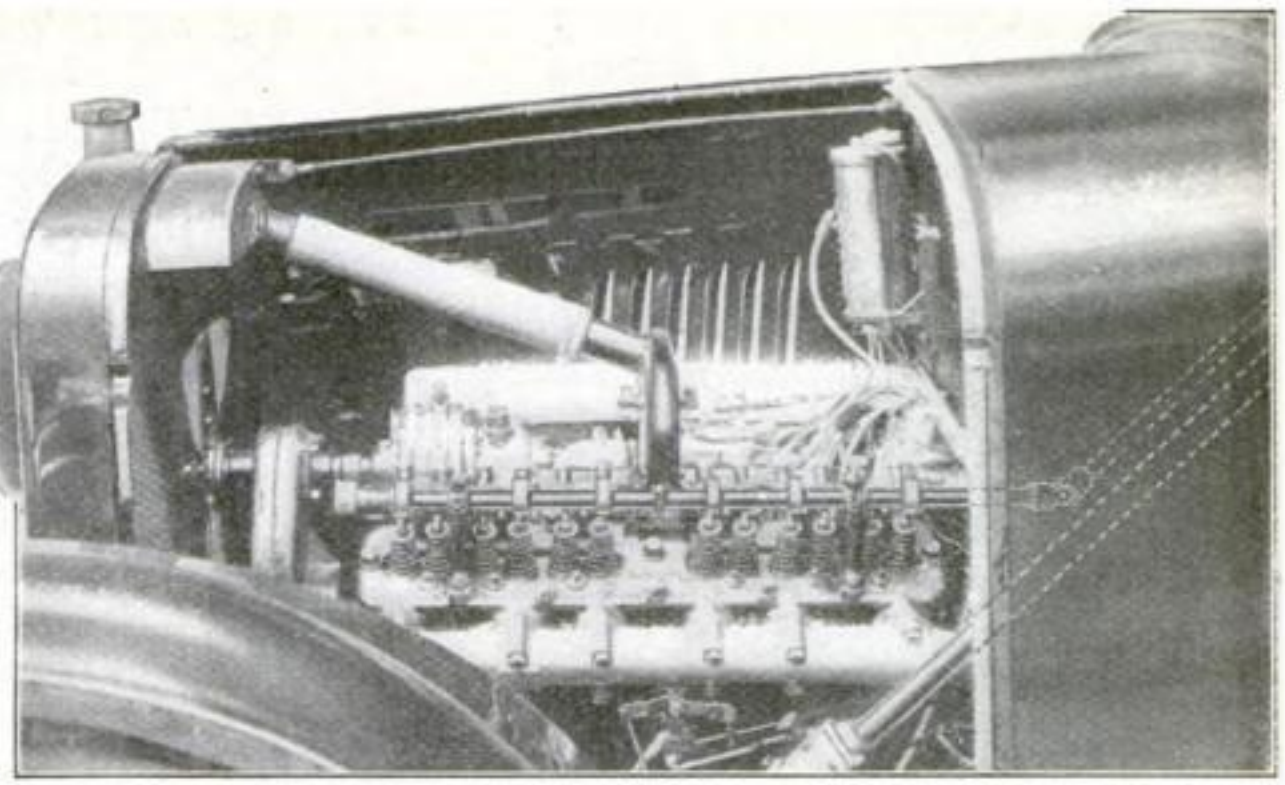
THE latest thing in automobiles is a car with a twelve-cylinder motor which can be changed to a six by the mere twist of the wrist. While it gives great power for quick acceleration and for hill climbing and flexible control on high gear, the twelve-cylinder motor is nevertheless a large consumer of gasoline and therefore expensive to operate. While the power of the twelve is advantageous under some conditions, the bulk of the driving of the ordinary car is done under conditions that could be equally as well done with a six as with a twelve-cylinder motor, and at a lesser consumption of gasoline. To meet these conditions, a Cincinnati automobile manufacturer has brought out a twelve-cylinder car which can be changed to a six at will, simply by turning a lever carried under the steering-wheel.

This transformation is secured by cutting out the left-hand block of six cylinders. The cut-out is in turn accomplished by means of a camshaft placed over the exhaust-valve rocker-arms. At the rear end of this shaft is a ball-and-socket joint connecting it with a shaft attached to the steering column and carrying at its upper end the operator's lever. The movement of this lever revolves the camshaft and presses the cams down upon the rocker-arms of the exhaust-valves and holds the valves open, so that there is no compression

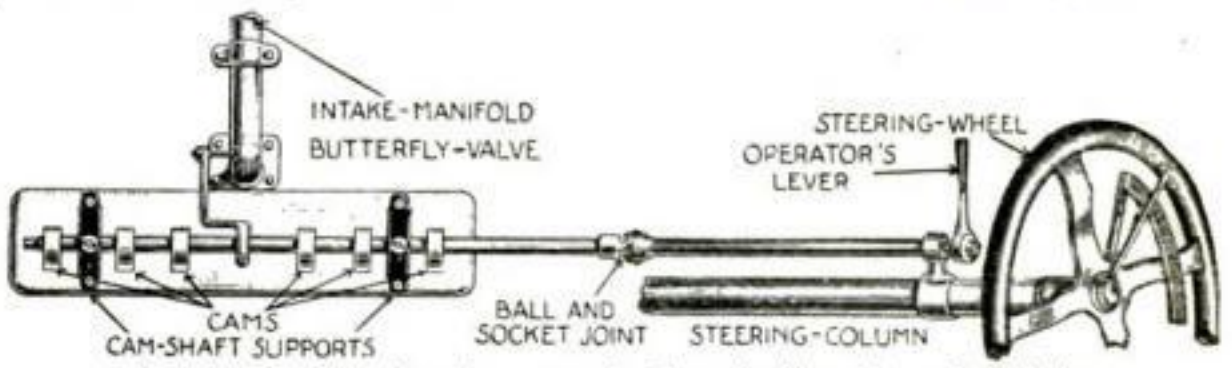


With the turning of the lever a butterfly valve in the left intake-manifold is closed so that no gas reaches the cut-out cylinders

in the six left-hand cylinders. The same movement of the lever also closes a butterfly-valve in the left intake-manifold as shown in the illustrations, so that no gas reaches the six left cylinders. All the reciprocating parts of the latter continue to operate regularly except that there is no compression or explosions, due to the fact that the exhaust valves are open and no gas can reach the cylinders. Under these conditions the motor operates as a six-cylinder type except that it has to carry the slight additional load of reciprocating the moving parts of the cut-out cylinders.



With the left six cylinders cut out all the other parts operate as usual except that the exhaust valves remain wide open



At the rear end of a camshaft a ball-and-socket joint connects with a shaft that leads to the operating lever

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The Cancer Problem and How Modern Science Is Attacking It

THE man in the street generally thinks of cancer as a hopelessly incurable disease which has attacked many of his friends and relatives and, like death itself, is too unpleasant to talk about. It rarely occurs to him that he may be the next victim, nor does he realize that if he is over forty years old there is one chance in fourteen that he will die of this disease, and as regards his wife, if of equal age, one chance in only eight. Yet if he stopped to consider what these figures mean he would perhaps decide that an ostrich policy of hiding from the unpleasant facts of life is in this case, as always, a serious mistake. Not, however, that he should lie awake nights worrying about the matter. An accurate idea of the frequency of cancer should merely stimulate a person of healthy intelligence to learn how to avoid the disease and how to prevent a fatal result if, in spite of all precautions, it should afflict him or a member of his family. Starting out on such an inquiry he would soon find that he was right in thinking cancer a common disease but wrong in believing it to be an unavoidable and incurable ailment.

Cancer is indeed more common than most people realize. In 1914 there were 54,420 deaths from all forms of cancer in the United States Registration Area, which comprises about 60% of the population of the country. If the same rate of fatality prevailed in the states and cities outside the Registration Area, over 80,000 persons in the continental United States must have succumbed to this malignant disease during that year. In his recently published book, "The Mortality from Cancer Throughout the World," Frederick L. Hoffman estimates that during the ten years ending with 1913 there were 658,139 deaths from cancer in the United States, and that the total of deaths from this disease in all civilized countries is not less than 500,000 annually.

From the annual reports of the Census Bureau, it is seen that cancer ranks fifth among the leading causes of death at all ages and that only tuberculosis, heart diseases, pneumonia, and kidney diseases take a greater toll of life. Considering only deaths that occur after thirty years of age, cancer presents an even more serious aspect. It is indeed primarily a disease of adult life, the average of death being 59 years as compared with 36 in the case of tuberculosis. In the United States Registration Area 83% of all deaths from cancer, during the years 1906–1910 inclusive, occurred at ages of forty-five and over.

Overcoming the City Boy's Fear of Snakes

The boys are proud of their knowledge that all snakes are not poisonous or dangerous

EVER since the old days in the Garden of Eden, when the first snake played its mean trick on human nature, man has been suspicious and even afraid of the whole writhing genus. But not all snakes are enemies to man. The farmer has found that many kinds of them are his friends. Superintendent Charles H. Woodhall, of the Boys' Club of Troy, New York, has started a collection of the harmless species and is making a big success of it. His boys, most of them street urchins, are very enthusiastic over the snakes. Mr. Woodhall specializes in work for boys. He takes long "hikes" with the lads into the country, and leads them to observe everything in outdoor life. He soon saw that the average boy is mortally afraid of snakes. The city boys, who tried to kill every snake, saw Mr. Woodhall catch the creatures in his hands, and explain their wonderful structure. At first the youngsters would run away in fright, but when they saw that the snakes were harmless, they, too, learned to handle them. The snakes were then taken to the Boys' Club, to form the collection of living specimens.

The lads became fascinated with this study of nature and living things, and explained the wonders of snake-life to other boys. The boys are proud of their knowledge of the reptiles, and are helping spread the news that snakes are the friends of the farmer, for they devour such pests as young rats, moles, and other grain-destroying creatures.

Now What Would You Call This New Musical Instrument?

HEDLEY WATTY, of Groton, Connecticut, has invented a puzzling musical instrument. On first examination it looks like a violin. But then it has a horn attached to its lower extremity. What is it? The lines of the instrument above the horn part are not at all in keeping with the construction of the violin. There is a long finger-board provided with frets, but there is only one string. The number of frets, however, is supposed to give as many different tones to the one string as would be obtained from the four strings of the violin.

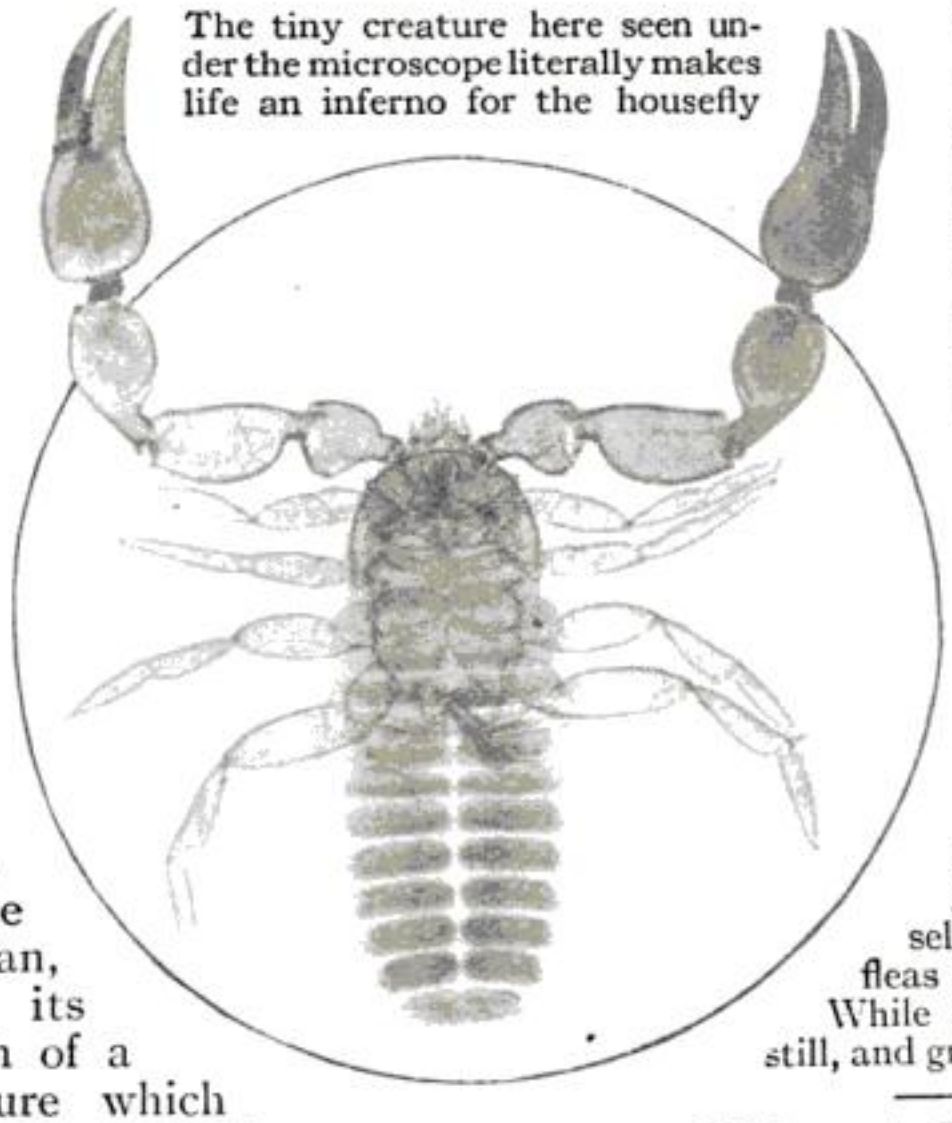
The specific use of the horn is to magnify the vibrations of the string. The horn is of aluminum. The transmission-bar, which has one of its ends connected with a diaphragm at the base of the horn, has its other end in direct communication with the string, thus serving as a bridge.

The musical tones are not exactly similar to those of the violin. Neither are they the tones of the mandolin, guitar or any other stringed instrument. They are emitted through the horn, which gives them a distinctly different quality.

With one string and an extra-long finger-board provided with numerous frets it produces as great a variety of musical tones as does the violin

"Great Fleas Have Little Fleas Upon Their Backs to Bite 'Em"

TO the naturalist or to any one accustomed to observe Nature closely, the fact is apparent that the problems of existence are proportionately the same in every form or stratum of life. Even the common housefly, which seemingly has nothing else to do but to crawl lazily over whatever is left uncovered and then go happily on its way, doing its best to bring about an affiliation between the clean and the unclean, occasionally meets its Nemesis in the form of a tiny crab-like creature which attaches itself to the fly's legs.



The tiny creature here seen under the microscope literally makes life an inferno for the housefly

These little creatures are known to the scientist as pseudo-scorpions, or cheliferes. They may sometimes be found between the leaves of old books that have stood unused for a long time, and also beneath the bark of trees and in mosses.

Although they are called false scorpions they resemble the true scorpions closely in general structure except for their minute size. But they have no poison gland as the true scorpions have. They attach themselves to other insects also, but they seem to be the special pest of the houseflies. Scientists suppose that they seize the fly's leg and hold on until the fly dies, either worried or frightened to death by the undesirable presence. When the fly is dead the little creature feeds on the body.

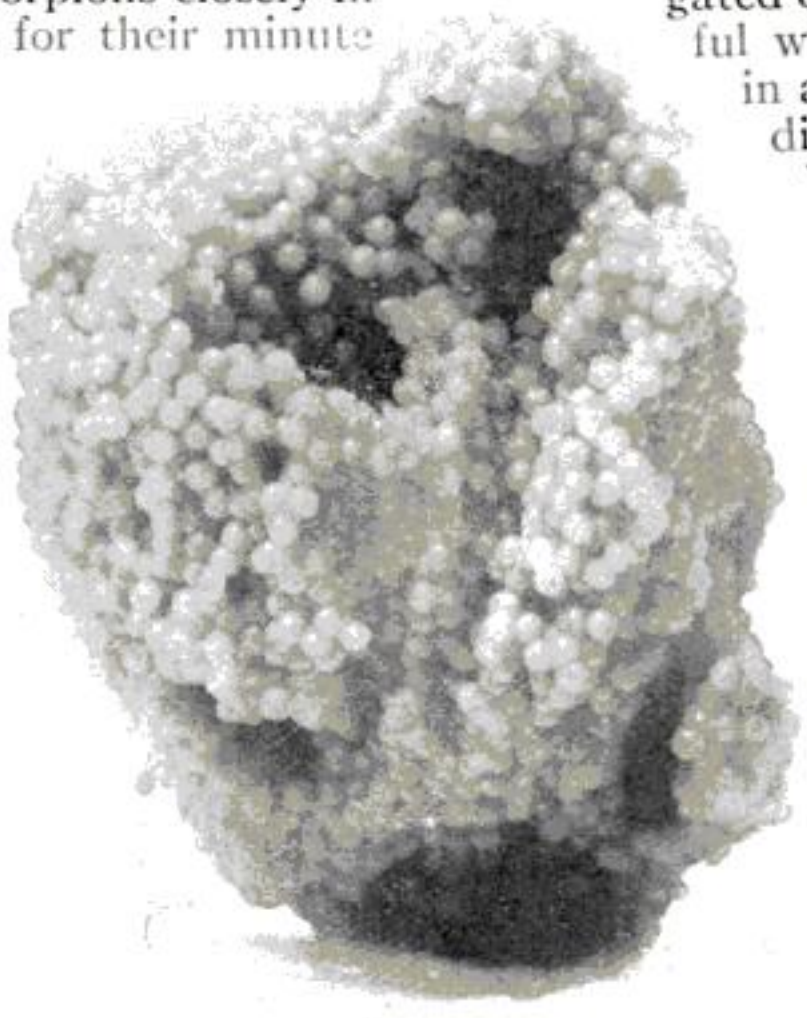
It is interesting to watch them under the microscope. A simple hand-lens will show them up to advantage. They are extremely active, running sidewise and backwards and gyrating in curious and amusing ways. It is easy to imagine the annoyance it causes the fly, when one or more of the pests decide to join hands with it; for whatever other activities the chelifer may find it never loses its hold of what is to be its storehouse of food eventually.

For, as De Morgan says:

"Great fleas have little fleas upon their backs to bite 'em;
And little fleas have lesser fleas, and so ad infinitum.
And the great fleas themselves, in turn, have greater fleas to go on;
While these again, have greater still, and greater still, and so on."

Iridescent Fish-Eggs for Table Decoration

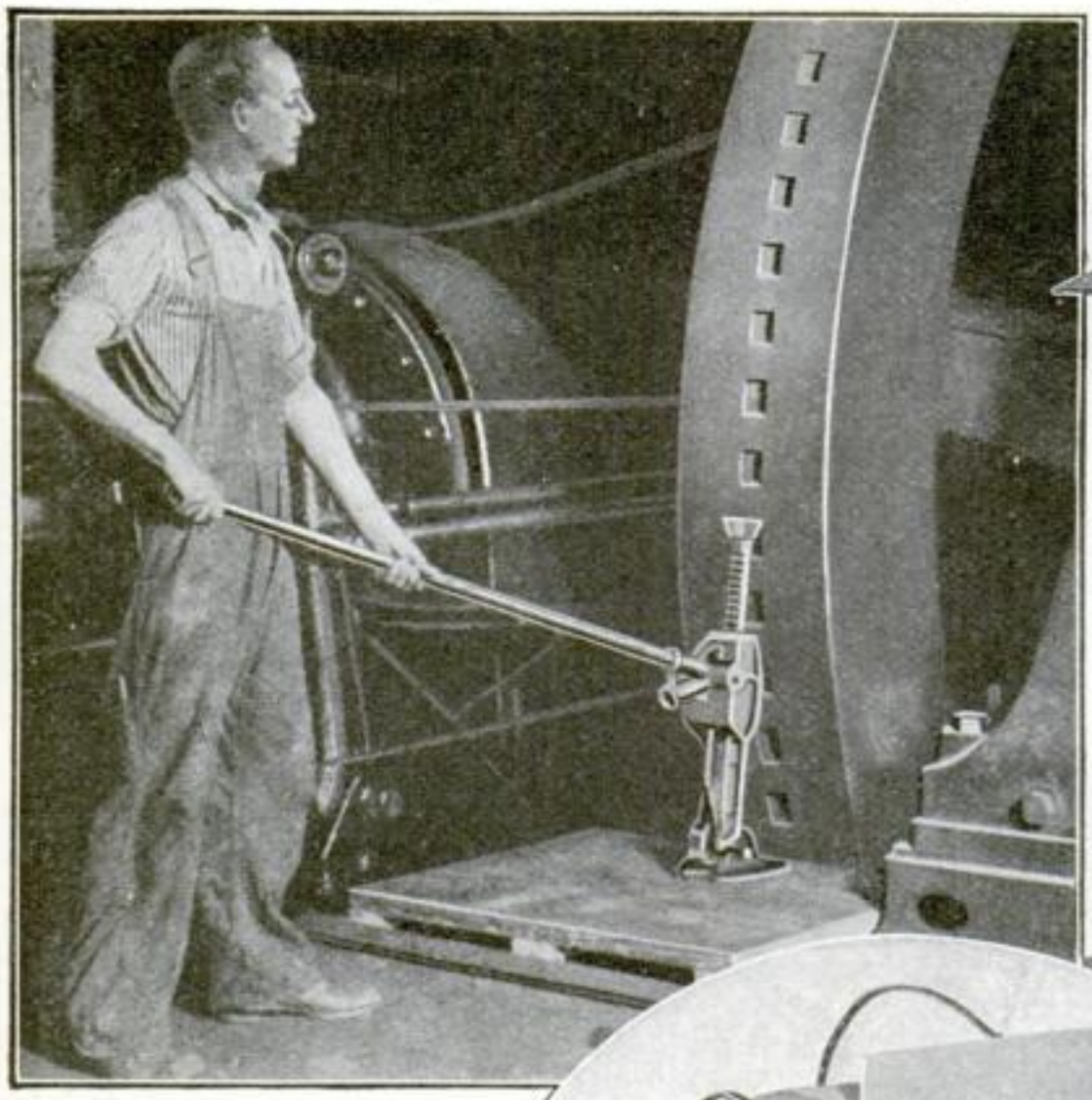
PERSONS living on the Atlantic coast, or visiting there during the summer, often wonder at the beauty of the various "berries" on seaweeds. Many a lover of the seashore, and of the beautiful, has gathered large quantities of these variegated objects. They are beautiful when artistically arranged in a glass receptacle so as to display the various colors, but they are not the fruit of a marine plant.



The eggs of the eighteen-spine sculpin arranged in a large jardinière for decorative purposes

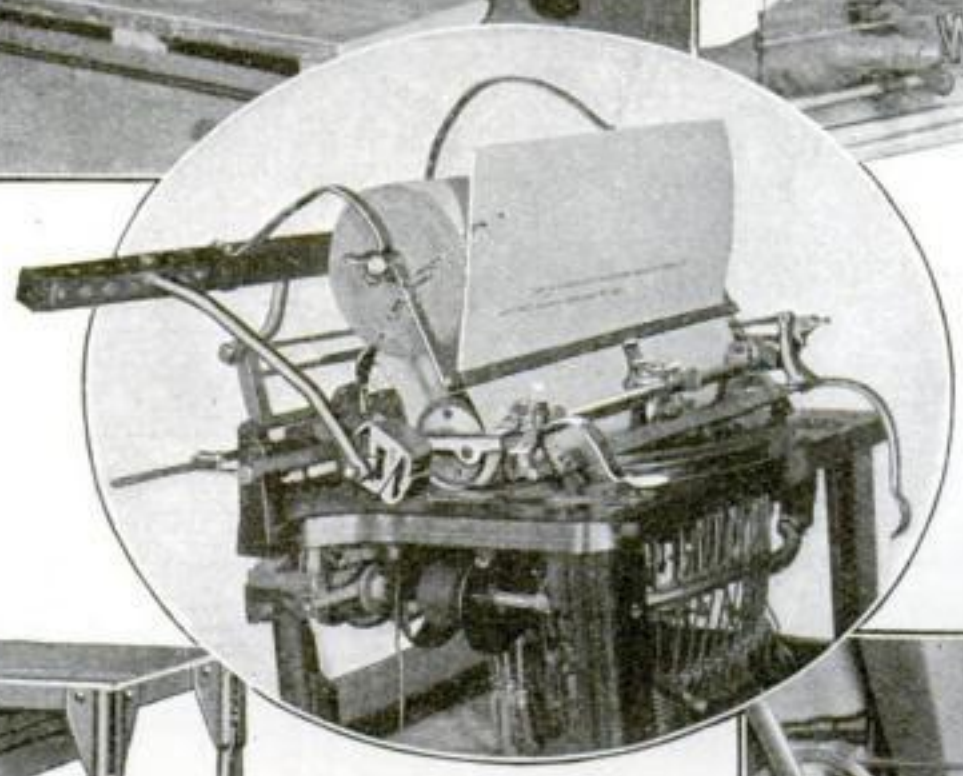
On the contrary they are the eggs of the eighteen-spine sculpin and of other allied varieties of sculpins, and they furnish an excellent example of the astonishing profusion of material with which nature works along certain lines in the propagation of species. She seems to realize that many fish are fond of these eggs and she intends that there shall be no diminution in the number of sculpins. She acts accordingly.

Mechanical Helps Which Fit You to Your



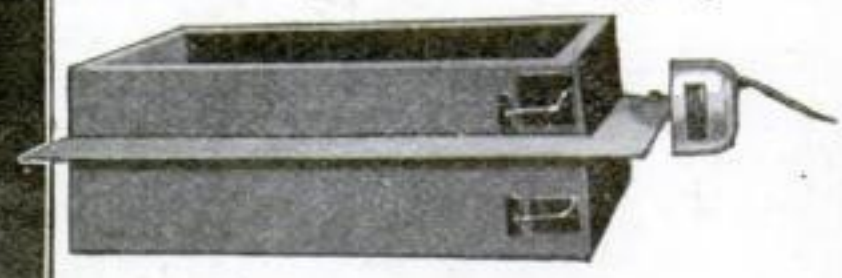
Above: A jack which turns a giant flywheel off the dead center

Below: A tool tray which, when reversed, becomes a smooth table top



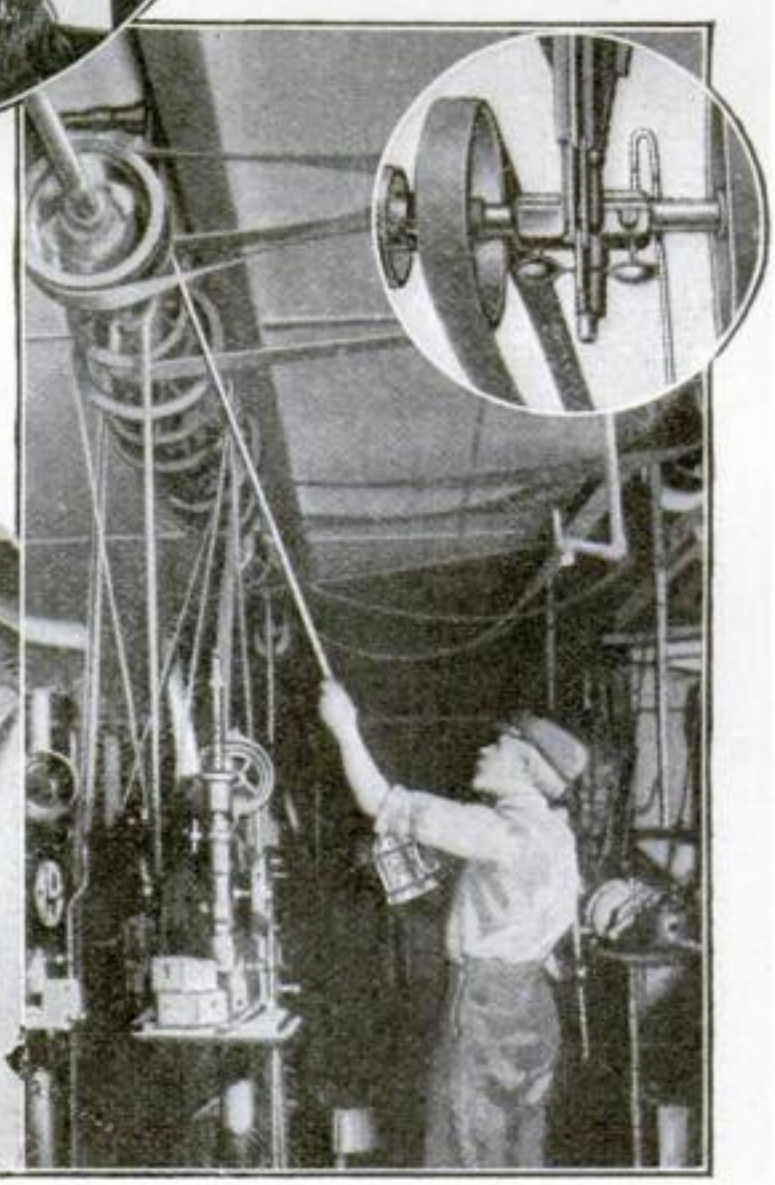
Above: A roll of typewriter paper used to write a letter of any length. A sharp knife cuts the paper off where desired

Below: An electric vibrator attached to a pattern-plate to take the place of hand rapping

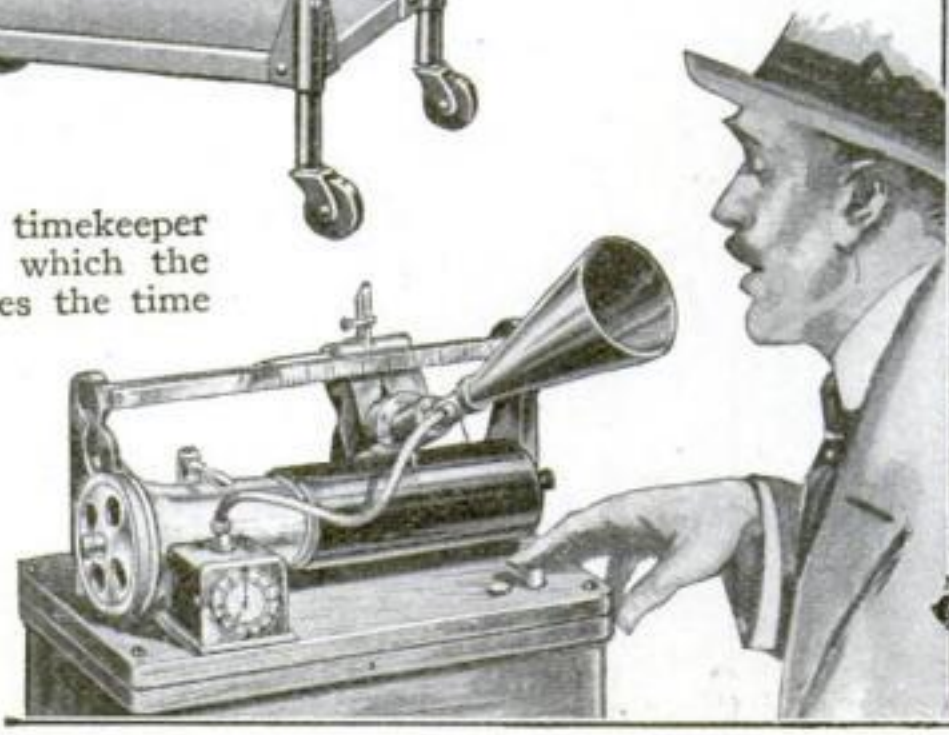


Above: A transparent changeable sign with celluloid letters which are set in grooves in the plate-glass sheet

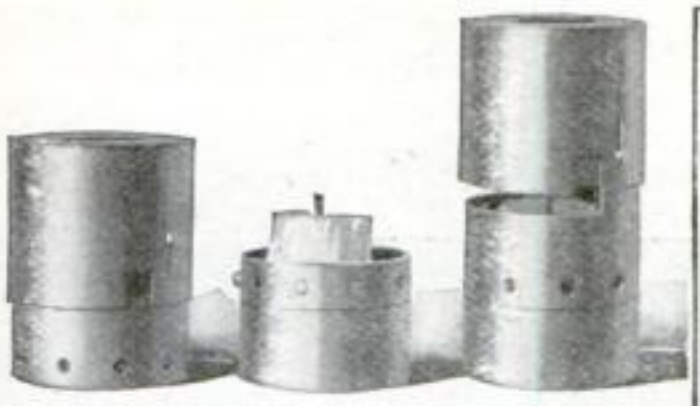
Below: A safety-first oil-can with a six or eight-foot spout. A thumb pump forces the oil where desired



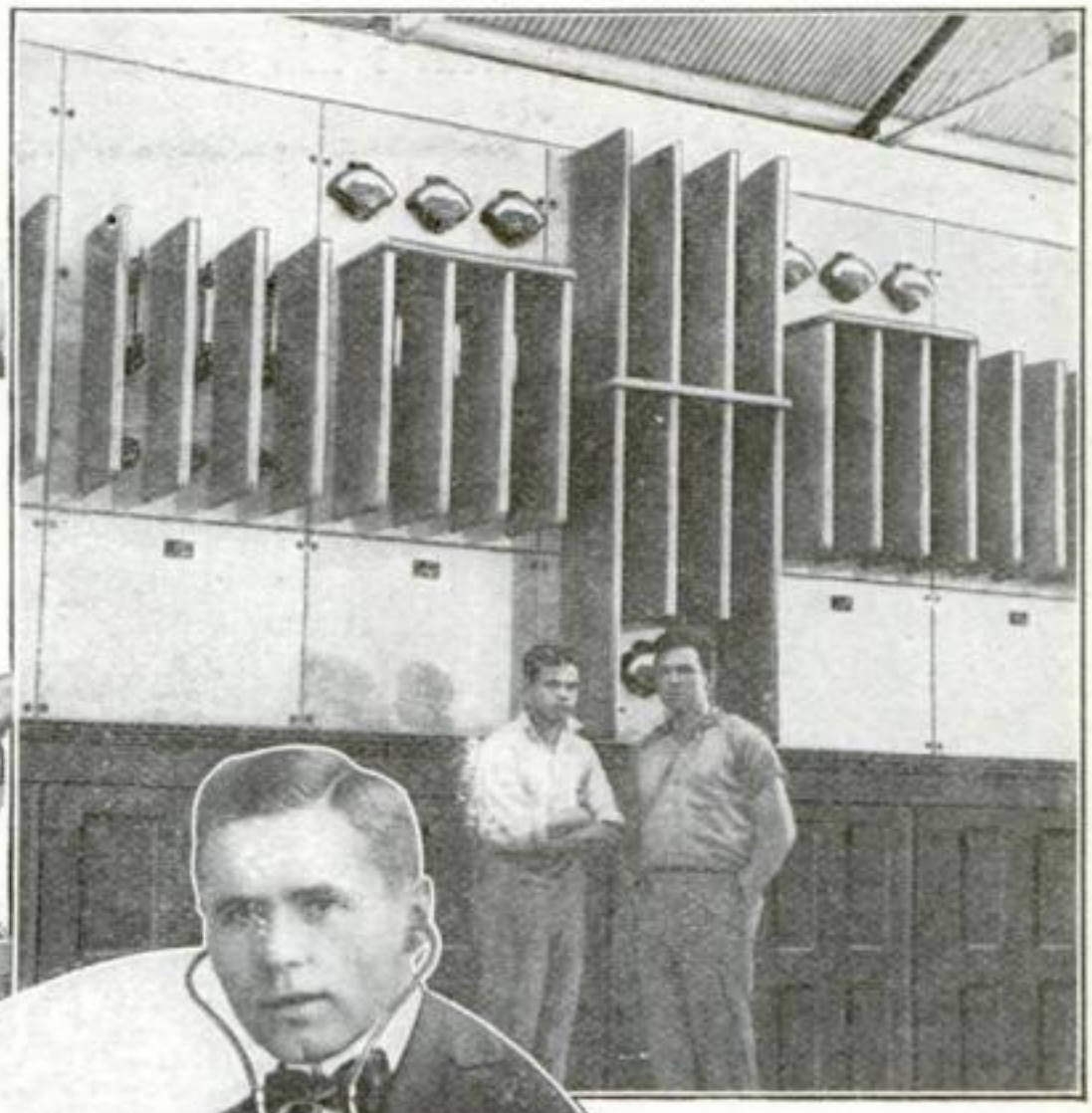
Below: A timekeeper device in which the clock strikes the time to be recorded on the phonographic cylinder. You give your name through the horn



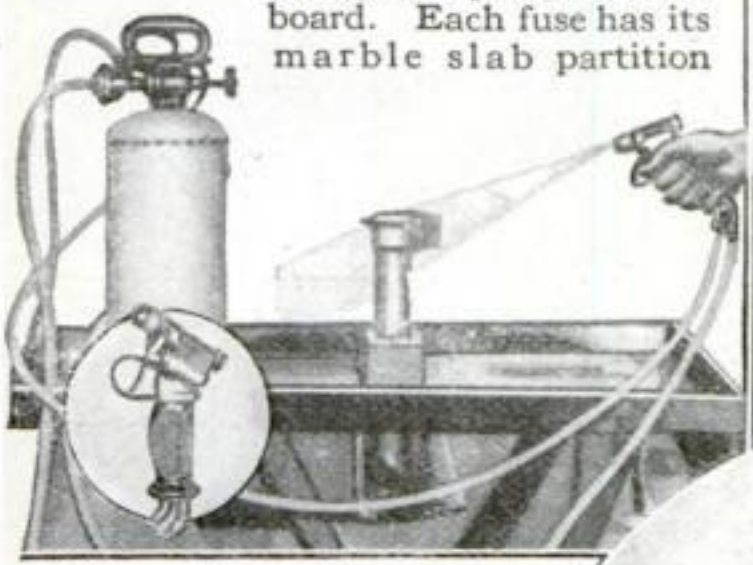
Job, and Save Time, Money and Effort



Above: A soldering lamp for telephone linemen. Heat is supplied by a candle



At right: A protected fuse board. Each fuse has its marble slab partition

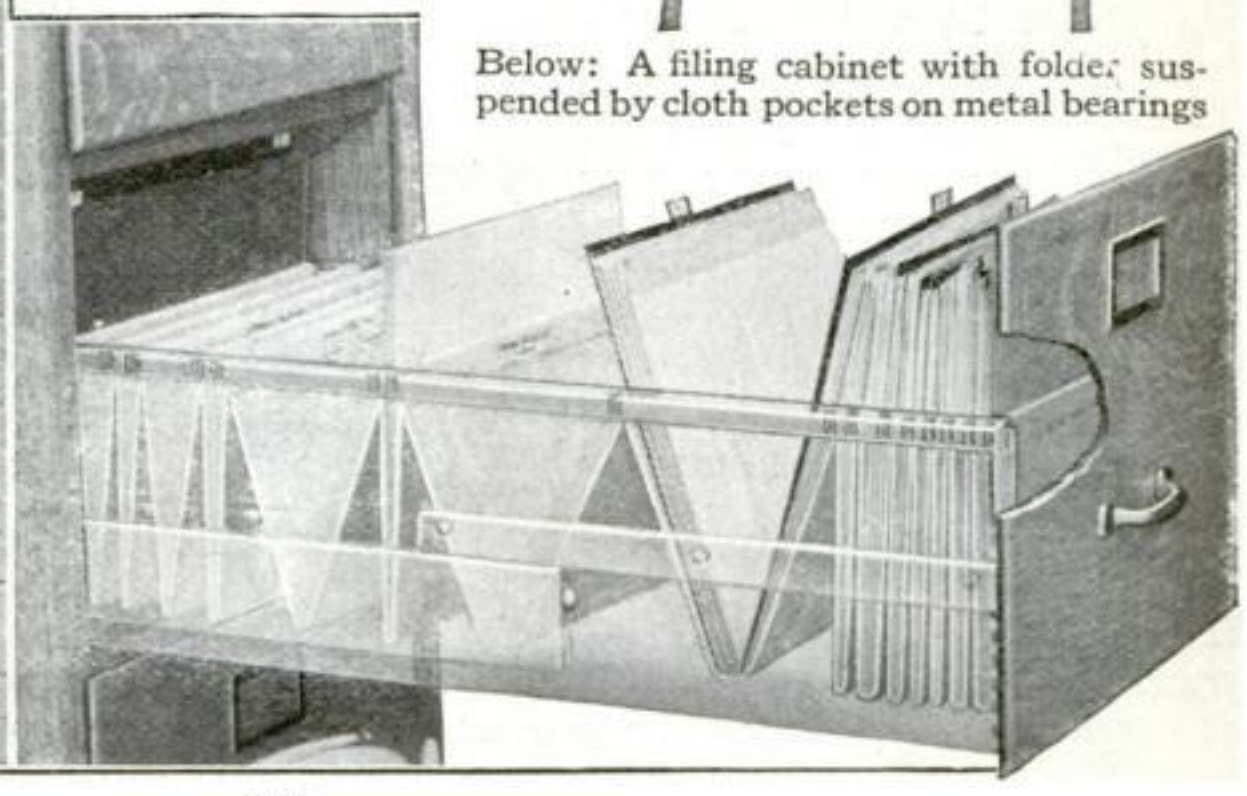


Above: A portable paint gun. Both paint and air are fed to the gun at constant pressure

Below: A window-cleaning chair of solid steel, with a firmly-clamped seat of heavy wood

Above: Hearing the telephone call with both ears by the aid of an ingenious ear-plug device. Your hands are free to write

Below: A typesetting-machine copy-stool to take the place of the usual dilapidated chair



Below: A filing cabinet with folder suspended by cloth pockets on metal bearings

Ax-Handles Made to Order

The boss chopper wants his ax-handles made to suit him

The wood must be straight-grained, free from knots and other defects

Roughly shaping the green handle

Making the opposite faces of the ax handles as nearly parallel as possible

ALTHOUGH nearly all ax-handles are machine-turned there is still a local demand in logging camps for the hand-made product. The boss choppers and sled-tenders are exacting in their requirements and provide a good business for the professional helve-maker who caters to their particular needs and whims.

Choppers generally use an ax with two edges or bits, one edge for clear chopping and the other for chopping knotty places where there is liability of striking the ground. The handle for a double-bitted ax is straight and has a "nub" at one end to prevent it slipping out of the grasp. Though simple in design, the making and fitting of such a handle requires considerable skill.

There is a knack in the choice of tree for ax handles. The wood must be straight-grained, free from knots and other defects, and naturally tough and strong. Medium-sized, thrifty trees are preferred; and usually only the butt-cut of some thirty-four inches in length is taken, as the remainder of the tree does not possess the inherent strength and resilience that years of resistance to the swaying action of the wind has imparted to the portion nearest the ground.

This bolt is quartered, and from each piece the heart is split off, leaving no trace to mar the clear whiteness of the sapwood. If a quarter is large enough for more than one handle it is divided accordingly. The bark is then hewed off and the piece flattened and roughly shaped. The final hewing leaves the handle blank "eight square," though strictly speaking, the cross-section of the handle at this stage is a flattened octagon.

The eight-squared blanks are taken to the shop, where all hewing irregularities are smoothed off with the draw-shave. This is followed by a small plane which makes the opposite faces as nearly parallel as possible. Two knobs are then left on the ends of the blank, one to form the nub and the other to form the part that fits into the eye of the ax. In reducing these to the desired shape the maker uses a crooked knife specially designed for cutting curves in wood. He holds the handle in his lap and shapes the nub. This portion is made larger for winter use when the chopper's hands are mittened.

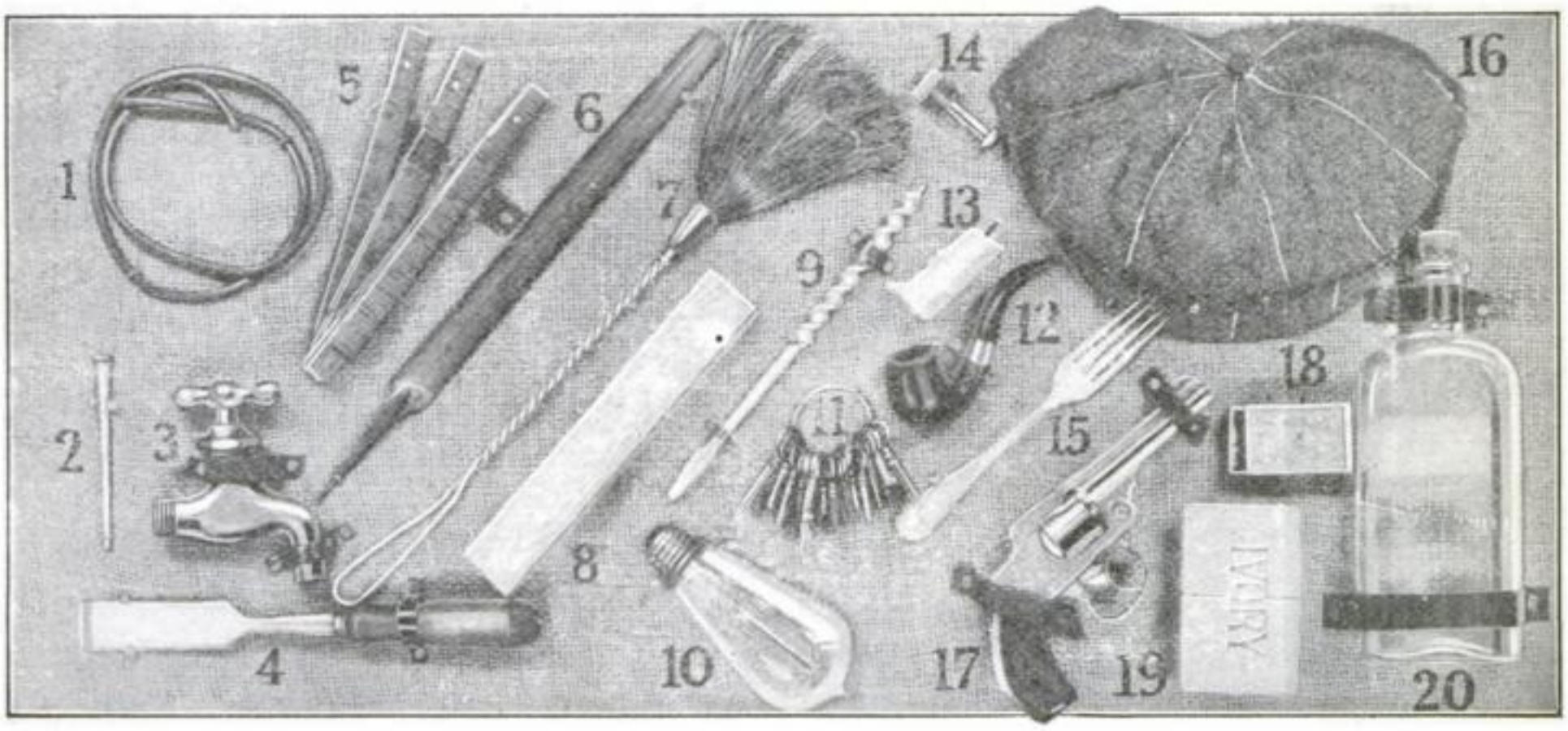
Finishing off the green handle and polishing it

When the nub is finished the rest of the handle is shaved down, the work being done from each end toward the middle. Some prefer that the lower grip of the handle be decidedly flattened, while others insist upon a more rounded form.

Choppers do not want their handles seasoned, as the drying makes the wood more brittle and reduces the flexibility. In order that the green handles may be properly smoothed, however, they are superficially dried on wires over the stove. They are then rasped and sandpapered.

Eyes Were Made to See With

Do you know how to use yours? Read this article and then test them with the picture



1—Wire
2—Nail
3—Faucet
4—Chisel
5—Rule
6—File
7—Fly Swatter
8—Block of Wood
9—Bit
10—Incandescent Lamp
11—Keys
12—Pipe
13—Candle
14—Bolt and Nut
15—Fork
16—Cap
17—Revolver
18—Match-Box
19—Soap
20—Bottle

ONE of the fundamentals of life, to which comparatively little attention has been given, is the ability to see straight. Very few of us see what is placed before us or what goes on under our very noses. Fortunately this faculty of observing correctly may be improved by practice, but first we must be made to realize that we are deficient in it. To prove this to classes of young engineers, Mr. W. H. Blood, Jr., performs a very simple experiment.

He has found it interesting to test his classes to see how far they have cultivated their powers of observation. On a board are mounted twenty objects, ten of them being ordinary household articles and ten of them simple mechanical or electrical objects. This is reproduced in the accompanying photograph. The numbers are not on the board itself but are used in the illustration for the sake of identification. The board is displayed before the class and the observers are allowed to look at it for a predetermined time; then the exhibit is covered and they are asked to write down the articles which they have seen. While this test in psychology does not prove much of anything, an analysis of the answers obtained certainly does give us food for thought.

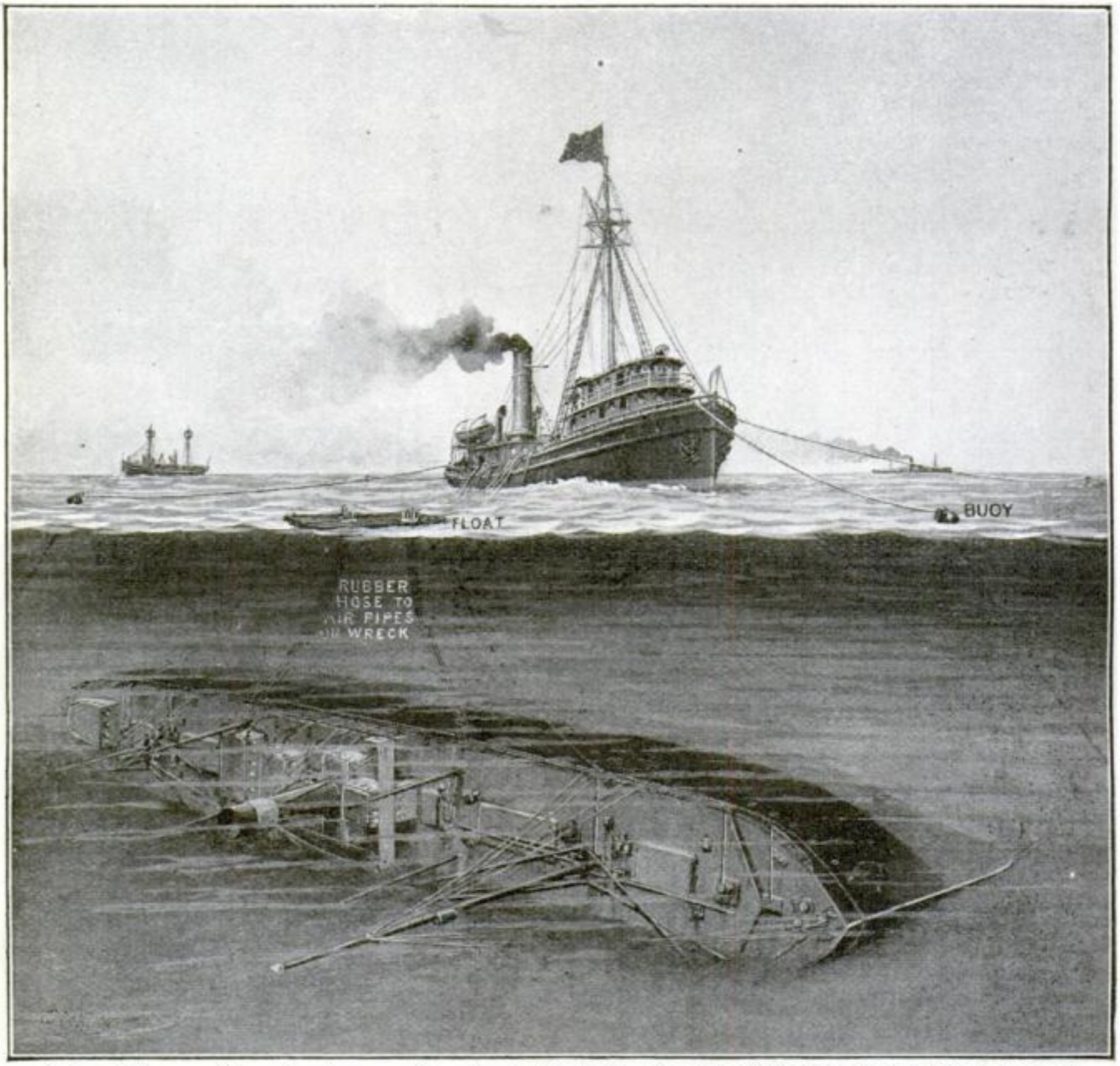
A recent experiment of this kind, tried on a large group of technical students, gave some startling results. Here was a group of educated young men who for half a minute gazed intently at these twenty articles. Several saw only three or four of the articles; the average for an entire class was but eight. What was the matter with these boys? Half awake, you say? Oh no, they were all wide awake, none more so. The test simply shows that these students have not been taught to observe. How can they make clear deductions if they are unable to tell what they have seen? Some of the men said the color of the burlap which covered the board was white, while others said it was black, yellow; only few said it was brown or buff. A curious fact brought out by this test was that nine out of ten put down on their list articles which were not on the board at all; they drew on their imaginations, but their guesses were not right. Of this entire class the best observer had but fourteen out of the twenty correct,—equivalent to 70 per cent; the average was 40 per cent, and the poorest was 15 per cent correct. A pretty poor showing for a group of technical men.

She Lies on Her Side—But They'll Raise Her

The "Washingtonian" foundered in ninety feet of water. They are floating her with compressed air

OUR present-day salvors, who no longer hesitate to attack with undaunted spirit sunken ships which have been given up as hopeless, will watch with interest the bringing of the American-Hawaiian freight steamship *Washingtonian* to the surface. The salvaging of the ship represents a new chapter in salvage history.

After a collision with the American five-masted schooner *Elizabeth* in a heavy fog off the Delaware Coast on January 26, 1916, the *Washingtonian* sank in ninety feet of water. Loaded to her full capacity with raw sugar brought from the Hawaiian Islands for Philadelphia, she sank in ten minutes. The sugar absorbed the inrushing waters and made the vessel so topheavy that she turned and went down on her side. Before she could be located, the water dissolved much of the sugar, thus saving the salvors the trouble of unloading her.



Lying fifteen miles out at sea under ninety feet of water the "Washingtonian" is being salvaged by compressed air. It is the most ambitious undertaking of the kind ever attempted

From the day that the vessel sank

Captain Lester A. Blake did not lose hope of her recovery, notwithstanding the fact that no vessel had ever before been salvaged while lying under ninety feet of water fifteen miles out at sea. Associated with Captain Blake in the venture are Theodore Wells, a naval architect, and William Wallace Wotherspoon, who introduced the compressed air method of floating sunken ships.

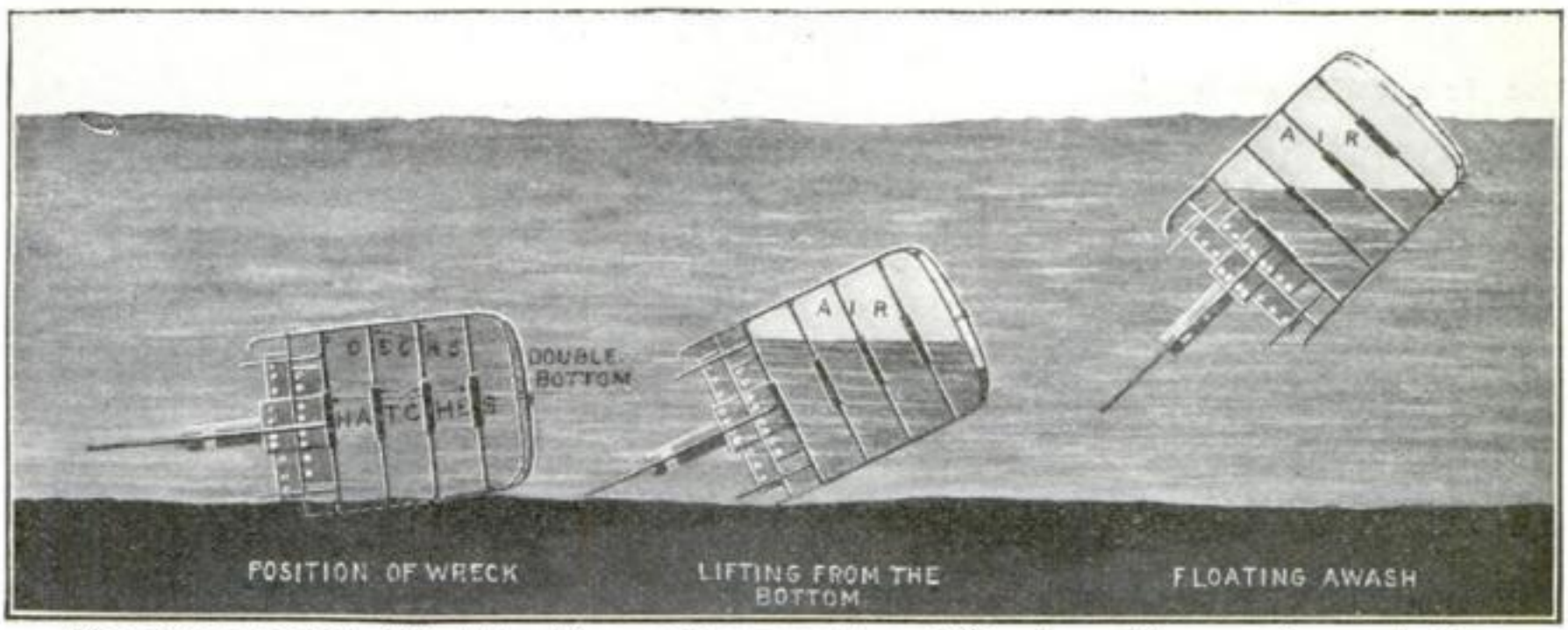
The *Washingtonian* is a steel ship approximately four hundred and twenty-eight feet long, with a fifty-foot beam. She is divided into eight watertight compartments between decks and has a watertight double bottom, extending practically the whole length of the ship. That portion of the hull which lies above the side of the hatch-openings nearest the surface formed a pocket into which compressed air was pumped. The double bottom proved to be an independent source of buoyancy.

Fortunately, the *Washingtonian* has vents extending to her upper or shelter deck. These vents lead to the several compartments, interdeck spaces, and the various tanks. The first step in salvaging the craft is the locating of the two distributing bases, one forward and one aft. To these bases flexible rubber hose, strongly protected by wire netting, was led to a surface float upon which individual connections were placed. The float was permanently anchored over the wreck. The compressed air from the pumps on the wrecking boat was sent through flexible hose connected with the outlets already established on the floats, and thence to the various parts of the sunken ship. The wrecking tug could thus leave the scene of the wreck when weather conditions prohibited working, simply by detaching the hose connections.

The accompanying illustrations show the way in which the vessel is to be raised. Air will first be blown into the double bottom, giving sufficient buoyancy to lift the ship off the seabed. To prevent her from turning bottomside-up a control tank with a lifting capacity of many tons will be attached by an adjustable purchase to the foremast. This will act as a lever to prevent the ship from upsetting. Finally, air is forced into the space between the decks and the upturned side, to bring the port side of the ship just level with the surface.

As soon as the *Washingtonian* is brought to the surface she will be towed inside the Delaware Capes where she will be grounded. It will then be a comparatively easy matter to right her. The water will be pumped out, her wound repaired and she will be refloated.

The scarcity of ships and the high freight rates have been two factors inspiring the saving of the ship. At the time the vessel was sunk she was valued, outside of her cargo, at a rough half million dollars. Today, if she were refloated and able to carry large cargos of munitions, she could bring a price as high as two million dollars.

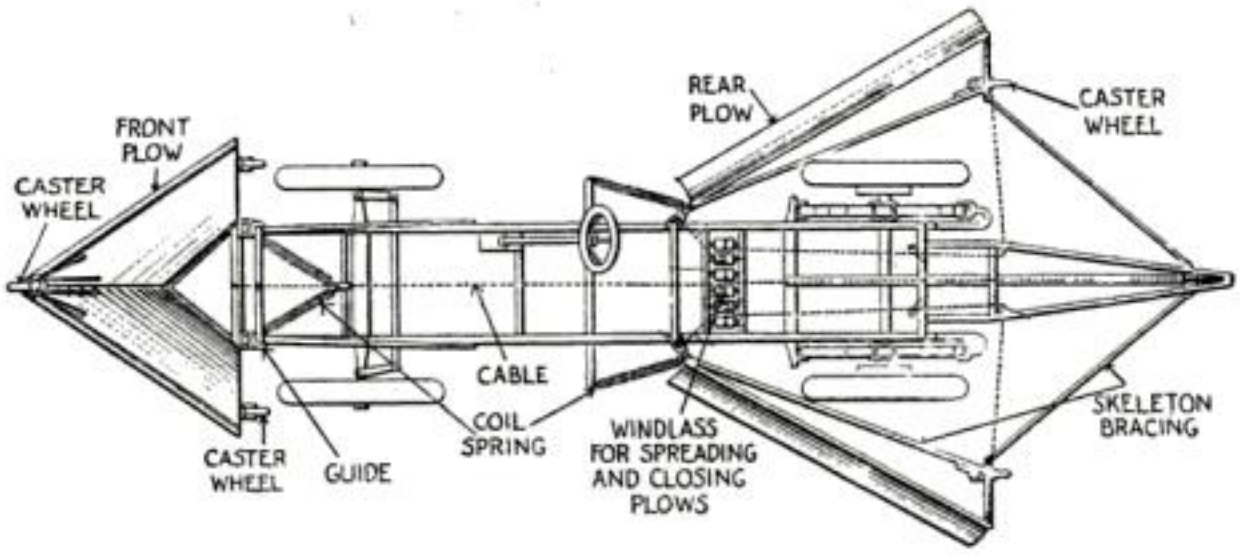


The salvors predicted that the ship would occupy three different positions as she rose to the surface. A control tank attached to the foremast prevents her from turning bottomside-up

Plowing Snow with Your Automobile

Front and rear plows on casters which can be adjusted to any motor-vehicle chassis

The front plow automatically turns and responds to the movements of the automobile



The rear plow can be contracted or expanded in order to make a narrower or a wider swath as desired

MOTOR-DRIVEN snow-plows have become a familiar sight in our large cities during severe snowstorms. They can scoop up more snow than a whole army of horse-drawn vehicles, and in some cities, notably New York, they have revolutionized the problem of snow removal. For the most part these plows have been attached to giant motor-trucks. Now it is possible for any motor car, from the smallest to the largest, to be equipped with a plowing attachment devised by John A. Keeler, of New Paltz, New York.

His invention embodies front and rear plows connected with the automobile in such a way that they can be adjusted up and down, laterally, and in a tilting position, and the rear plow contracted or expanded to make a wider or a narrower swath. Both plows are provided with caster-wheels, so that they will turn to the right or left as the automobile is turned. To hold the front plow directly ahead, coil springs are used. The springs are so arranged and are of such strength that the plow will be drawn up or down according to the elevation of the road.

To raise and lower the rear plow and to spread and close it, a windlass is provided. The rear plow is attached to the automobile frame, as is the front plow; but it has the additional support of a skeleton bracing. This plow runs on three caster-wheels. Cables attached to it wind around the windlass. When the windlass is operated in one direction, the plows are spread, and when operated in the opposite direction, they are drawn toward each other. For the purpose of raising and lowering the plow independent cables are used.

Stirrup-Stoves Afford Comfort for Cold Horseback Riders

UNDOUBTEDLY the traffic squad of the police can testify to the fact that all is not gold that glitters and that all is not comfort and pleasure that seems so. Especially is this true in very cold weather, when the gallant blue-coat seated on his beautiful charger is a worthy subject for the camera-fiend, even though his blood may be congealing in his veins and his feet rapidly becoming like blocks of ice.

The general belief is that the easiest way to keep the entire body comfortable during the cold weather is to apply heat to the feet. Acting on this idea, William French, Clintwood, Va., has invented a heater to be attached to the riding stirrups, so that policemen or other equestrians may be kept warm, however low the mercury in the thermometer may drop. The heater comprises an outer shell of metal, covered with leather so that it is inconspicuous, and lined inside with asbestos, so as to eliminate danger and conserve all the heat. In this casing a drawer is arranged to slide in and out easily. In this drawer the fuel is placed. This may be a large lump of charcoal or coke. Ventilation holes are provided through which the heat may be regulated at the pleasure of the rider. These holes are so arranged as to provide for a circulation of the heated air and the gases around the foot of the rider.

The hot air and gases circulate in the casing around the rider's foot

An ash-pan is also provided, which may be made to answer the additional purpose of a storage place for unused fuel so that the fire may be replenished at intervals.

An Electrically Heated Foot-Board for the Policeman

IN Pittsburgh, Pa., the humane city officials have adopted a plan for providing for the comfort of the policemen while on duty. The post where the policeman is supposed to spend most of his time is provided with a small board or planking which is connected by wires with an ordinary electric battery in the call box on the corner or in any other available place. The current is regulated so that the heat generated will not exceed a comfortable degree.

The plank is connected with the battery in the call box

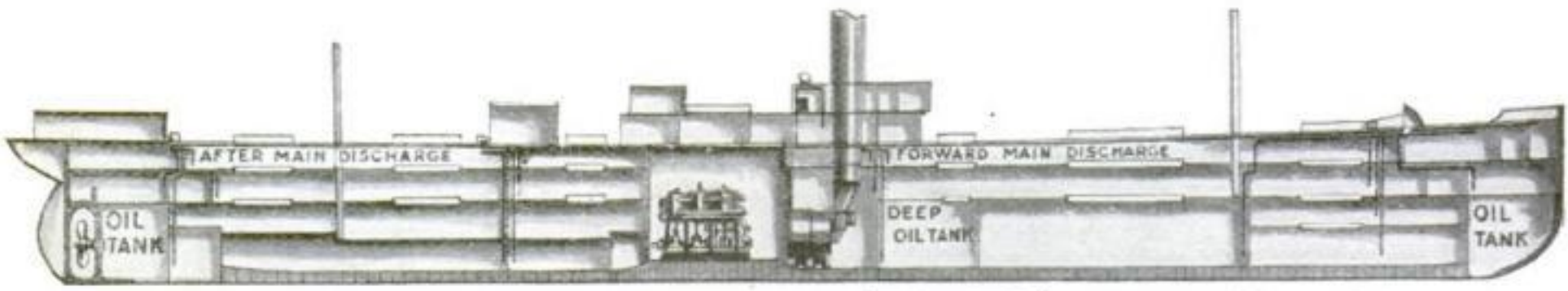
By this arrangement the feet are kept off the cold streets during the very severe weather, and when the sidewalks are dry a certain amount of solid comfort is available even for the policeman.

When he leaves his post he pushes a button and turns off the current.

When he returns to his post it requires only a few minutes to make the board just as comfortable as it was before the heat was temporarily turned off.

Asphyxiating a Fire with Sulphur

An apparatus which protects a ship against flames and assures it a clean bill of health

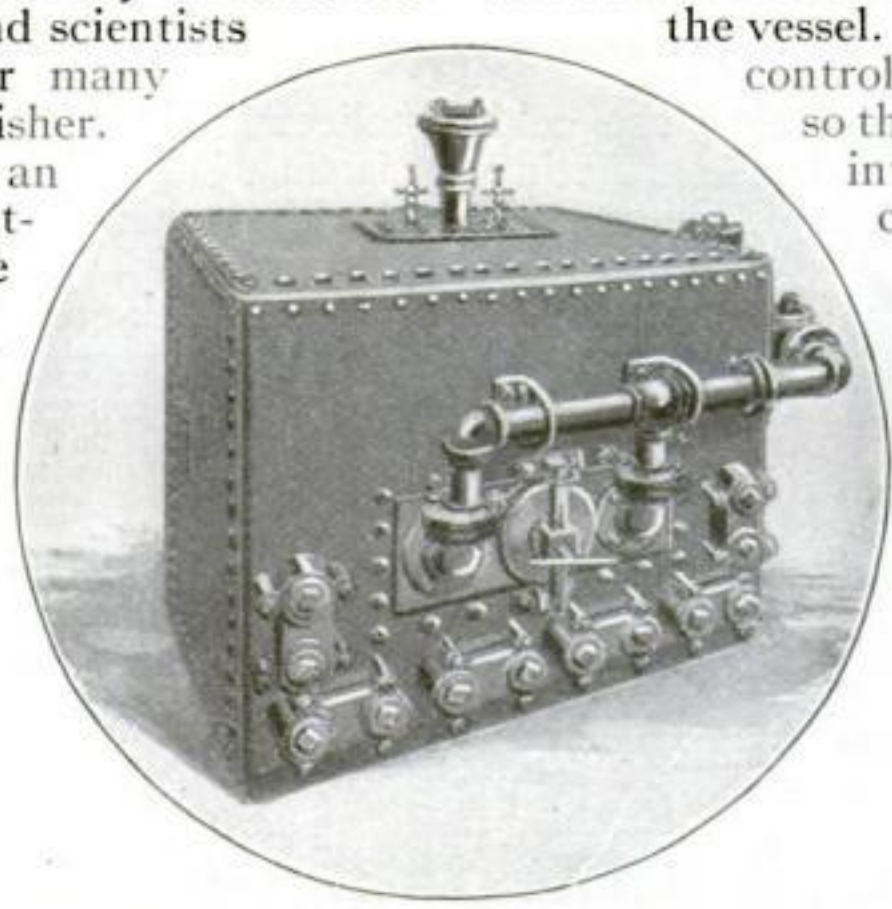


The fire-extinguishing and fumigating apparatus installed in the Minnesotan. After and forward main discharge-pipes connect with branch pipes which lead to each compartment of the vessel

ONE of the lessons learned in fighting ship fires is that the ideal form of extinguisher in an enclosed space like the hold of a ship is a gas which displaces the air by its own specific gravity, and is itself a non-supporter of combustion. This gas is found in sulphur dioxide, made when needed from ordinary commercial sulphur. Engineers and scientists have recognized it for many years as a fire-extinguisher. On the other hand, as an efficient gas for fumigatting purposes, its value has been admitted for some two thousand years. It would seem, therefore, that an apparatus devised to utilize the gas as both a fire-extinguisher and fumigator aboard ships would meet with great success.

Such an apparatus has been installed on the American-Hawaiian steamship *Minnesotan*. It consists essentially of a furnace, a blower and an engine. The furnace is built on the principle of a marine boiler. Sulphur is admitted into the melting pot through the top, and compressed air is pumped directly into the furnace. The gas formed from the air and sulphur is conveyed from the top of the furnace back and forth through tubes surrounded by circulating water. This cools the gas, after which it is discharged through a pipe, and carried to its destination under pressure. Furthermore, the gas can be made of a quality or density to suit a fire-extinguishing or a fumigating case.

The gas machine is placed in a steel deckhouse on the upper deck just abaft the smokestack. From this point after and forward main discharge-pipes connect with branch pipes which, in turn, extend to within two feet of the floor of each hold in the vessel. All the branch lines are controlled by manifold valves, so that the gas may be forced into any one of the several compartments.



The furnace is built on the principle of a marine boiler. Sulphur is admitted through the top, and the gas is conveyed through tubes

All of the piping is of galvanized iron. Fittings are avoided wherever possible, bends being substituted. While a separate pipe line for the gas is usually provided, a combined gas and steam installation has been worked out on the *Minnesotan*. However, all pockets where condensed steam could collect have been eliminated, and there is always a free flow of water to the drains provided, so as to keep the pipes as dry as possible for the gas.

One very important feature of the apparatus is a provision which keeps the gas from being drawn from the machine through the pumping apparatus. Only air is pumped, and that into the furnace where the gas is generated. The gas does not come into contact with the blower outfit at any time during the operation of the apparatus, either in fire-fighting or fumigating.

A Platform on Wheels for the Lamp Repairer

THE work of keeping the electric lamps along Michigan Avenue, Chicago, in shape has been greatly facilitated by the use of a frame platform on wheels for the convenience and safety of the repairman. It consists of a frame-work of steel tubing built on a three-wheel base and supporting a small platform at proper height for a man upon it to reach the lights. There is a rail for the protection of the operator.

The platform gives the man plenty of room in which to work and has its advantages over a ladder, in giving a space for placing globes and other parts within easy reach. The apparatus can also be used for painting the posts.

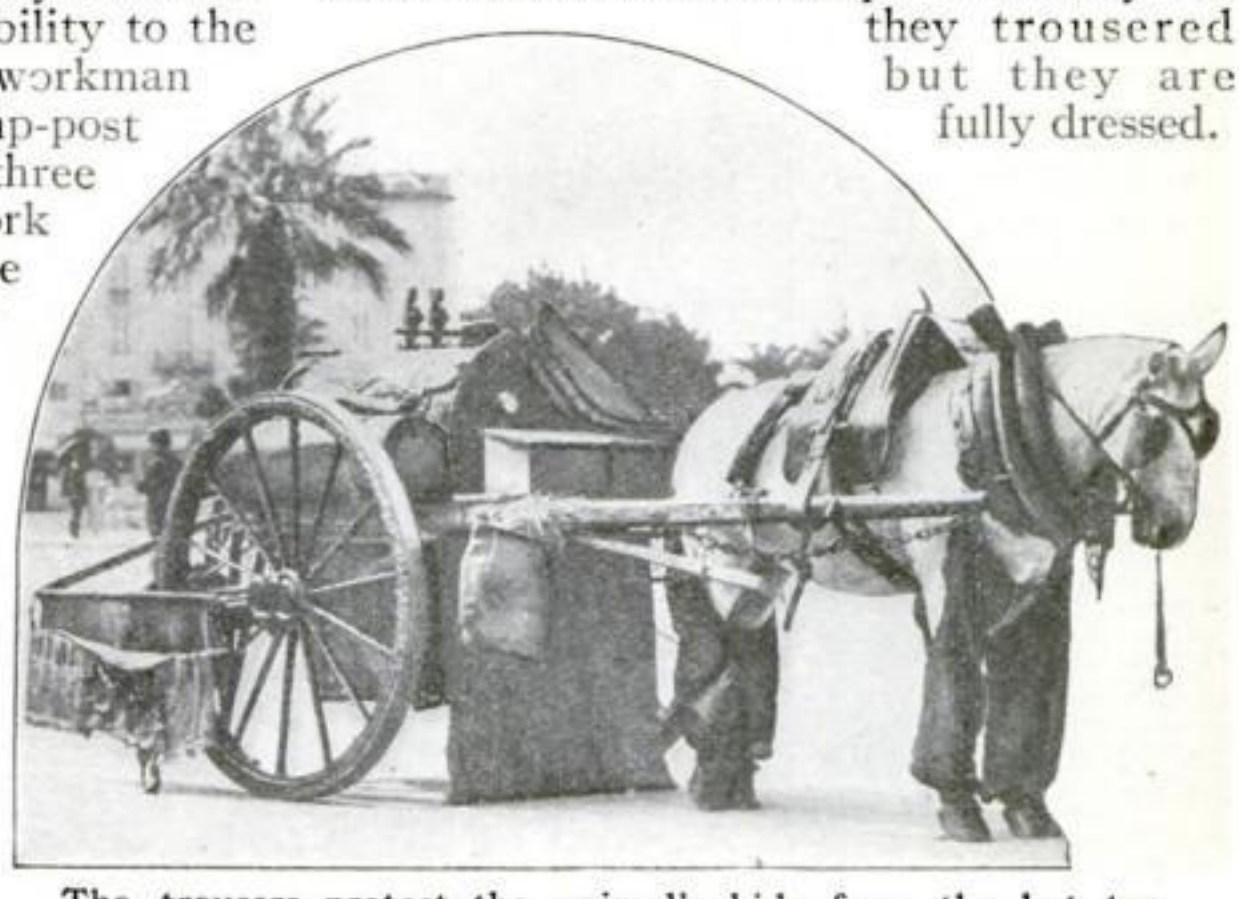
A groove is provided in the center of the platform into which the lamp-post fits closely

When the work on any one post is done, the entire apparatus, which is on rubber-tired wheels, is pulled away to the next one. The platform can be placed close against the post, as there is a groove on the top to fit the center into the middle. Underneath it is firmly attached to the post by means of bolts. This serves to give stability to the platform as well as to bring the workman close up to the lamps. The lamp-post braces the floor, just as the three steel tubes of the frame-work brace the rim and sides. The complete structure is strong enough to instill confidence into the worker and he is able to do his repairing and cleaning without inconvenience or danger. This apparatus is said to be more convenient for the workers than raised platforms on motor-trucks. The fact that the grooved platform enables the men to work close up to the lamps instead of reaching for them is its chief advantage.

Have You Ever Seen a Horse Wearing Trousers?

SOMEHOW the horse in the picture below looks ashamed. Perhaps he feels conscious of the bagging of his trousers. Evidently they are not a perfect fit. Or perhaps he has never worn them before and he is simply trying to get a good look at them. For all the work-horses in Nice, France, where the photograph was taken, do not go trousered. It is only when they are called upon to do special work that they don the pantaloons.

Trousers serve to protect the animal's hide when the wagon behind him is spreading tar over the streets. A curtain is suspended between the cart and the horse, but the trousers afford evidence of the extra care that is taken to prevent the discomfort and disfigurement which the hot tar might cause to the animal. However, France is not the only country that can boast of trousered horses. In South America a carnival is never complete without its trousered horses and sheep. Not only are they trousered but they are fully dressed.

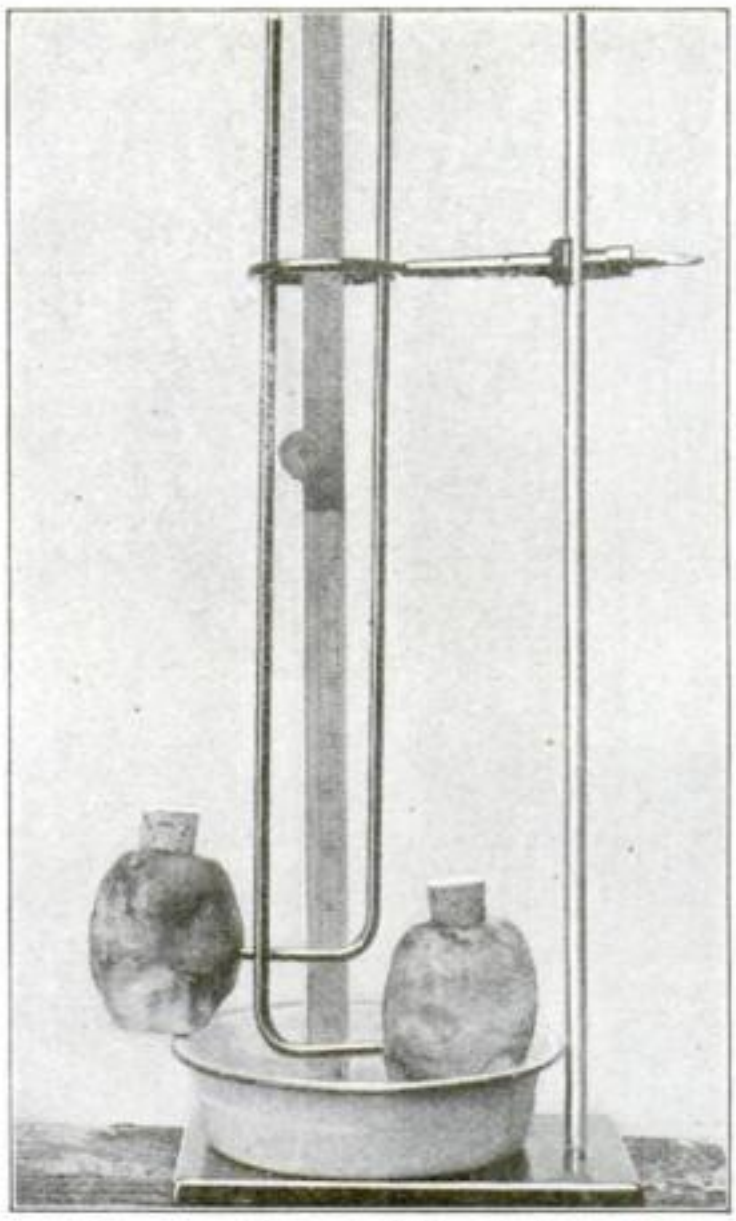


The trousers protect the animal's hide from the hot tar which is being spread on the streets from the cart behind

Why Does Sap Rise in a Tree Against the Pull of Gravity?

NOT everybody knows that solutions of two different substances placed on opposite sides of a membrane or a pulp make diligent efforts to equalize their density.

For example, take a glass tube, cut off the lower end of a potato, and peel the remainder for about one-third of its length. Bore a one-inch hole through two-thirds of the potato and in the end fit a cork. Bend a glass tube into L-shape, put vaseline on the short arm and insert it in a small hole bored in the side of the potato to reach the big hole. Fill the interior of the potato with sugar colored with ink, fasten the cork and glass tubing tight. Place this apparatus in a dish of water. The water, flows through the pulp of the potato and on reaching the thin membrane separating it from the colored liquid it diffuses more quickly through the colored liquid than the latter does through it, because it is less dense than the colored liquid. This causes the water to push the denser liquid upward into the tube. This action, together with capillary attraction is what causes the sap to rise.

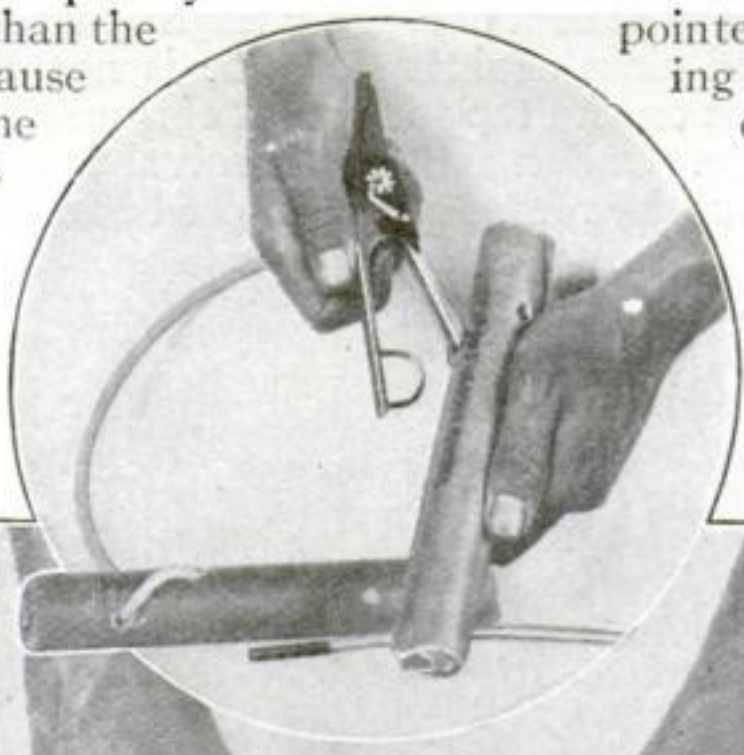


An experiment with potatoes to illustrate the principle involved in the rising of sap in a tree

A Time-Saving "Safety-First" Tool for Dynamite Workers

MAKE-SHIFT methods of crimping dynamite caps and connecting the cap and fuse to the cartridge have led to scores of severe accidents and many fatalities in land-clearing work. A combination tool, which will cut and slit the fuse, crimp the cap on the fuse and finally punch clean-cut holes in the cartridge for the secure fastening of the cap and fuse to the cartridge has been devised by V. D. Livingston, land clearing demonstrator, Wisconsin College of Agriculture.

The arrangement for slitting the end of the fuse exposes a pocket of powder which will ignite quickly. The crimping device at the center of the tool does a neat job and a strong one. When properly used to crimp a cap to the fuse, it requires a twenty-five pound pull to remove it. One of the handles has a pointed end, designed for punching the holes in the dynamite cartridge. The apparatus is intended to save time as well as to insure the safety of the workers.



A combination tool which will cut and slit the fuse, crimp the cap and punch clean holes in the cartridge

If Robinson Crusoe Had Only Thought of This

The sentinel's hut made out of the keel of a discarded boat. When made watertight by patching and filling the gaps it made a comfortable enough shelter

THE average man has enough ingenuity to build a shelter for himself anywhere. If ordinary materials are not at hand he immediately proceeds to find something that can be made to answer the purpose, whatevermay have been the use for which it was originally intended. The man in the photograph was doing sentry duty "somewhere" in the war zone, and the only material he could find that was at all available for shelter was the keel of an old boat that had been beached and discarded by its owners.

This he cut in half and erected as shown, using the short lengths and waste pieces of board for a door and to fill in the gaps. In this he was protected from every kind of weather.

Curios Made by Glass-Blowers in Their Spare Moments

THE automatic glass-blowing machine has not only supplanted the man who formerly did the work by hand but has deprived the glass-blower's friends and relatives of the many curious and interesting things which it was his custom to make during his spare time for his own amusement or profit.

Valentine Reineger of Alton, Ill., 65 years old and a retired glass-blower, had the distinction of being one of the most expert in the country at making odd pieces. His productions ranged from articles in common use to those of warfare, and he frequently blew images of animals.

The glass pipe shown in the illustration was his most difficult piece. It is five feet high. The bowl is three inches in diameter and six inches deep. It would hold nearly a pound of tobacco. The pipe is decorated and weighs nearly ten pounds.

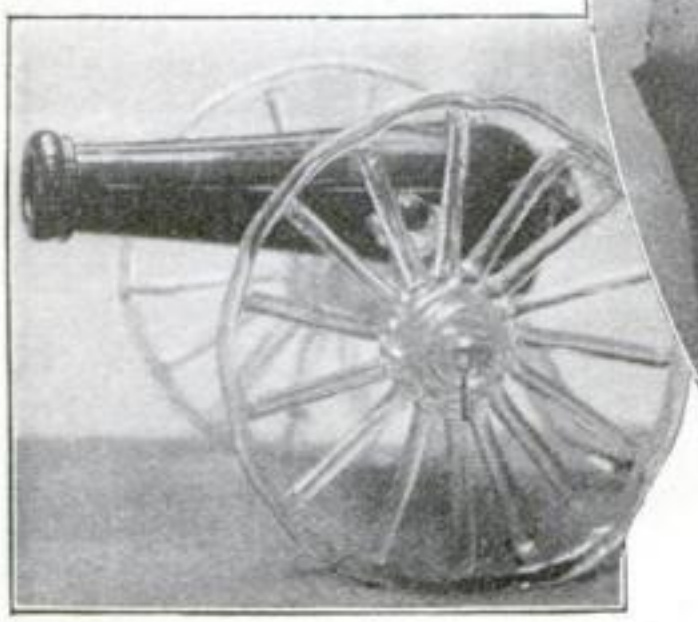
Of course the pipe is intended only for ornamental purposes. It would be hard to conceive of the most inveterate smoker indulging in a full-pound smoke, unless he happened to be sitting at an Indian peace conference.

The cannon at the left is of blue and flint glass. The greatest difficulty encountered in making it was in securing a balance. A sword and sheath of flint glass and of natural size is another implement of war made by Mr. Reineger.

His blown-glass animals include horses, cows, reindeer and alligators which are true to life in almost every detail of general appearance.

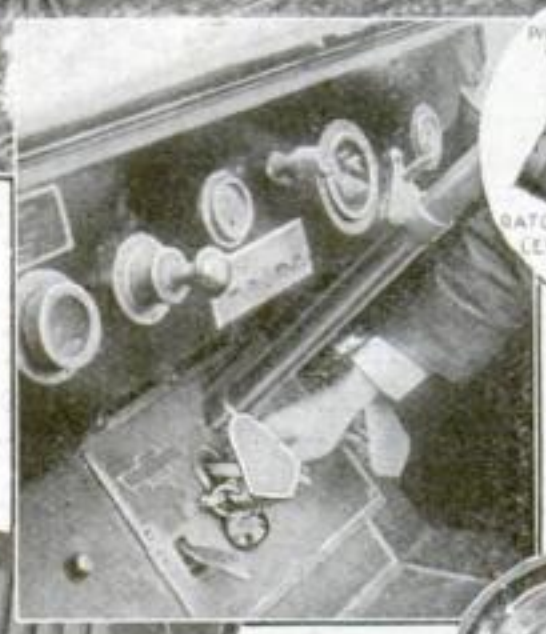
At right: Valentine Reineger with his ornate blown-glass pipe which holds almost a pound of tobacco

Below: The cannon, which is made of blue and flint glass finely balanced



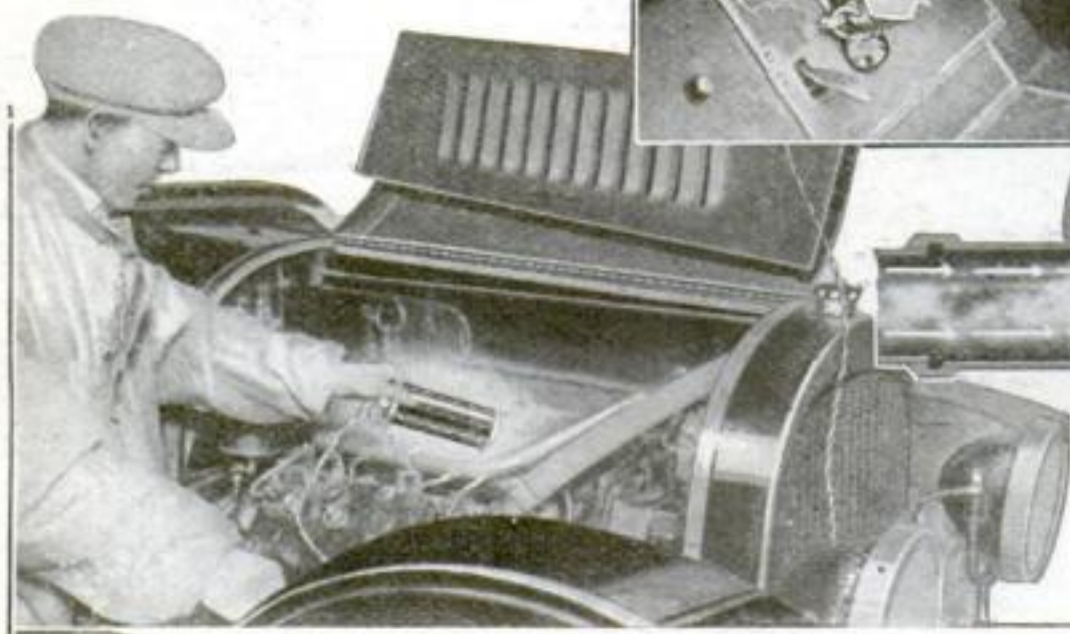
The Time, Labor, and Money-Savers Among

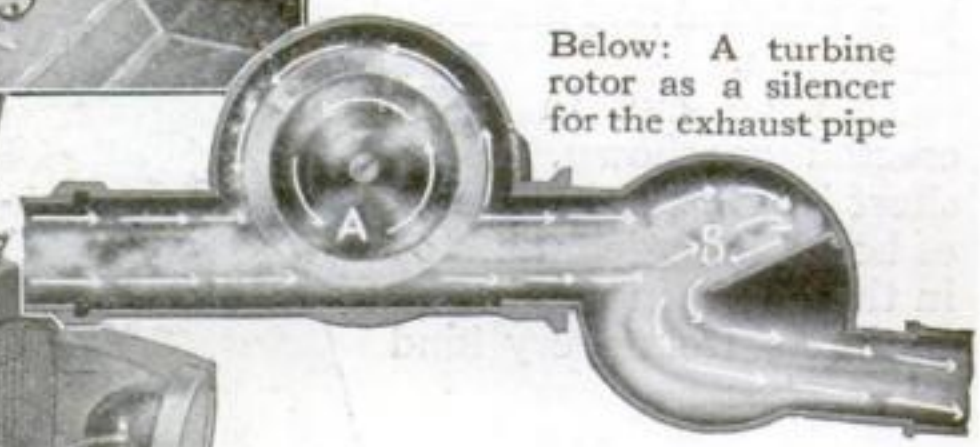
Above: Threshing with a Ford. The power is taken directly off the crankshaft by means of a novel device



Below: A lamp socket warmer for engine and radiator during the winter

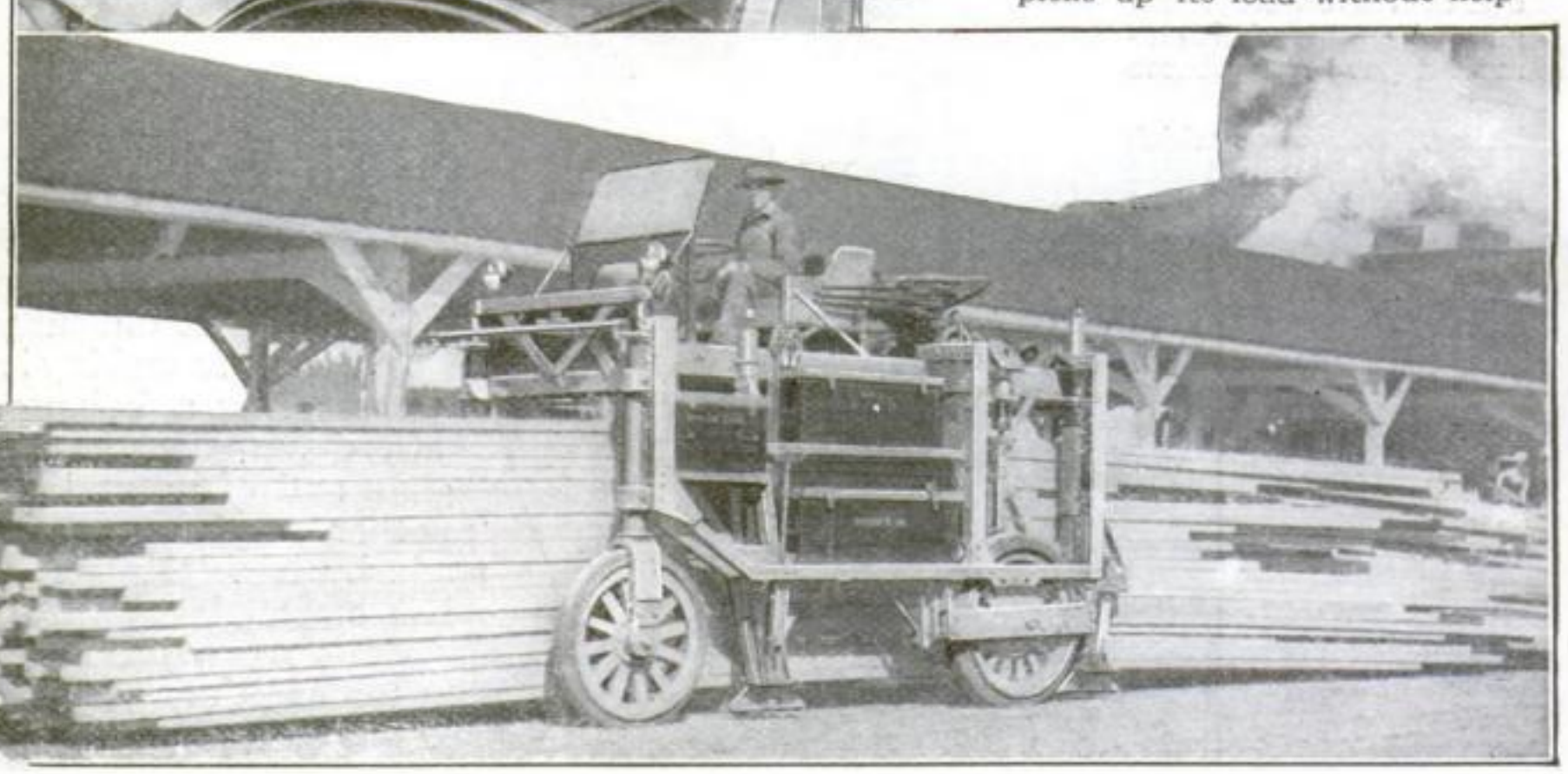
At left: A brake-pedal lock to prevent theft. The lock is a wedge-bolt inserted between levers





Below: A turbine rotor as a silencer for the exhaust pipe

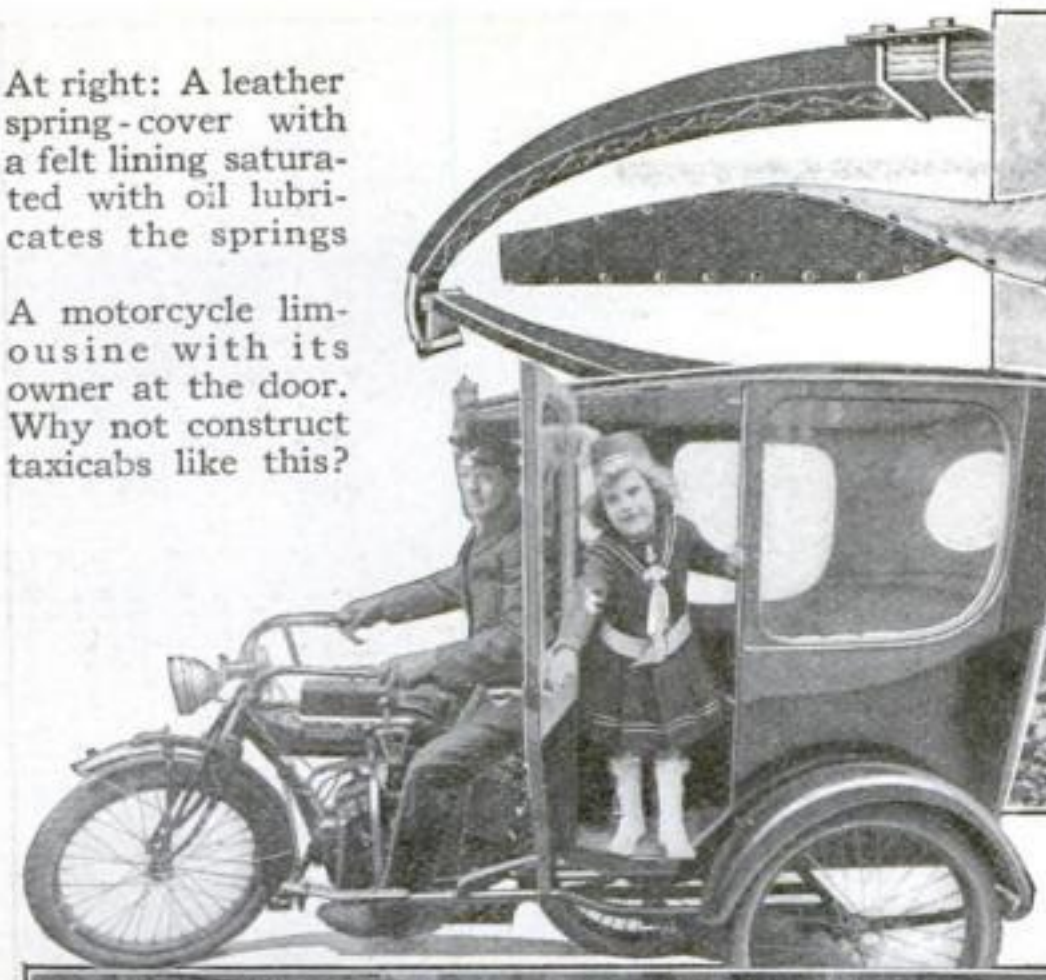
Below: A lumber truck which picks up its load without help

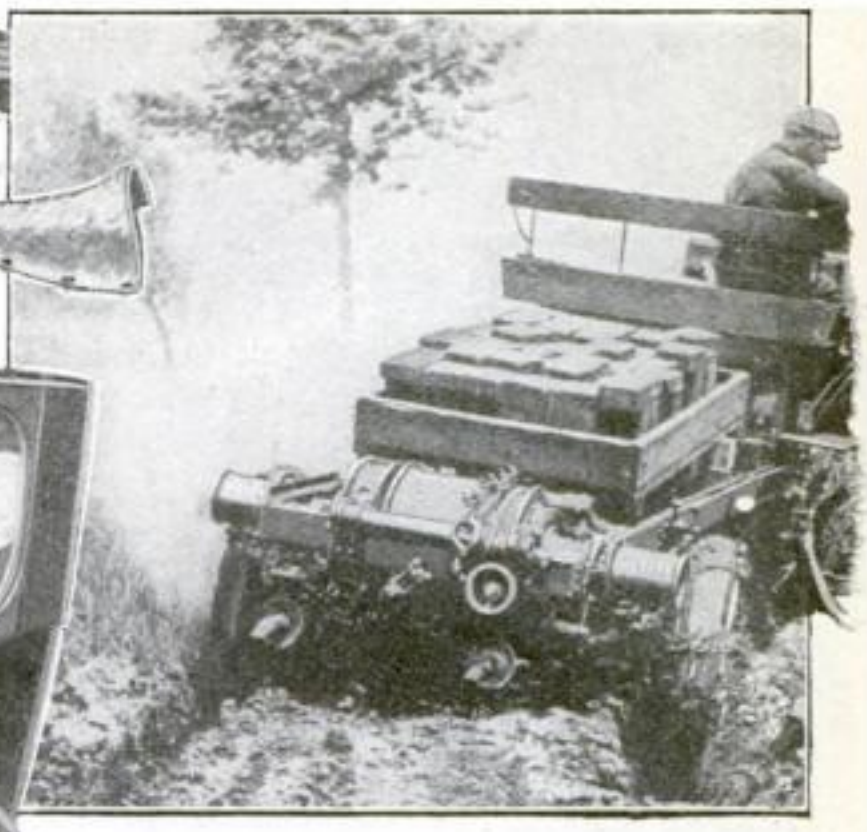


Recent Improvements in Motor-Driven Vehicles

At right: A leather spring-cover with a felt lining saturated with oil lubricates the springs

A motorcycle limousine with its owner at the door. Why not construct taxicabs like this?



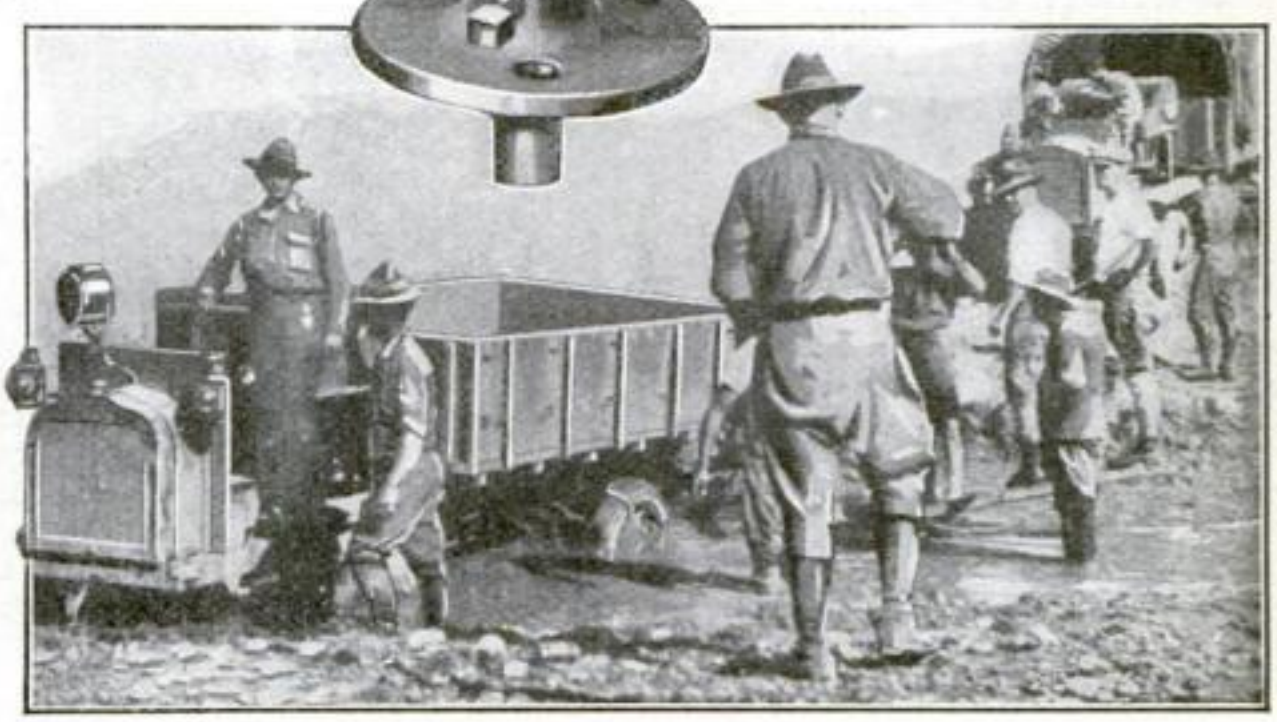


Above: A wrecking truck with a power winch and lengthy steel cable

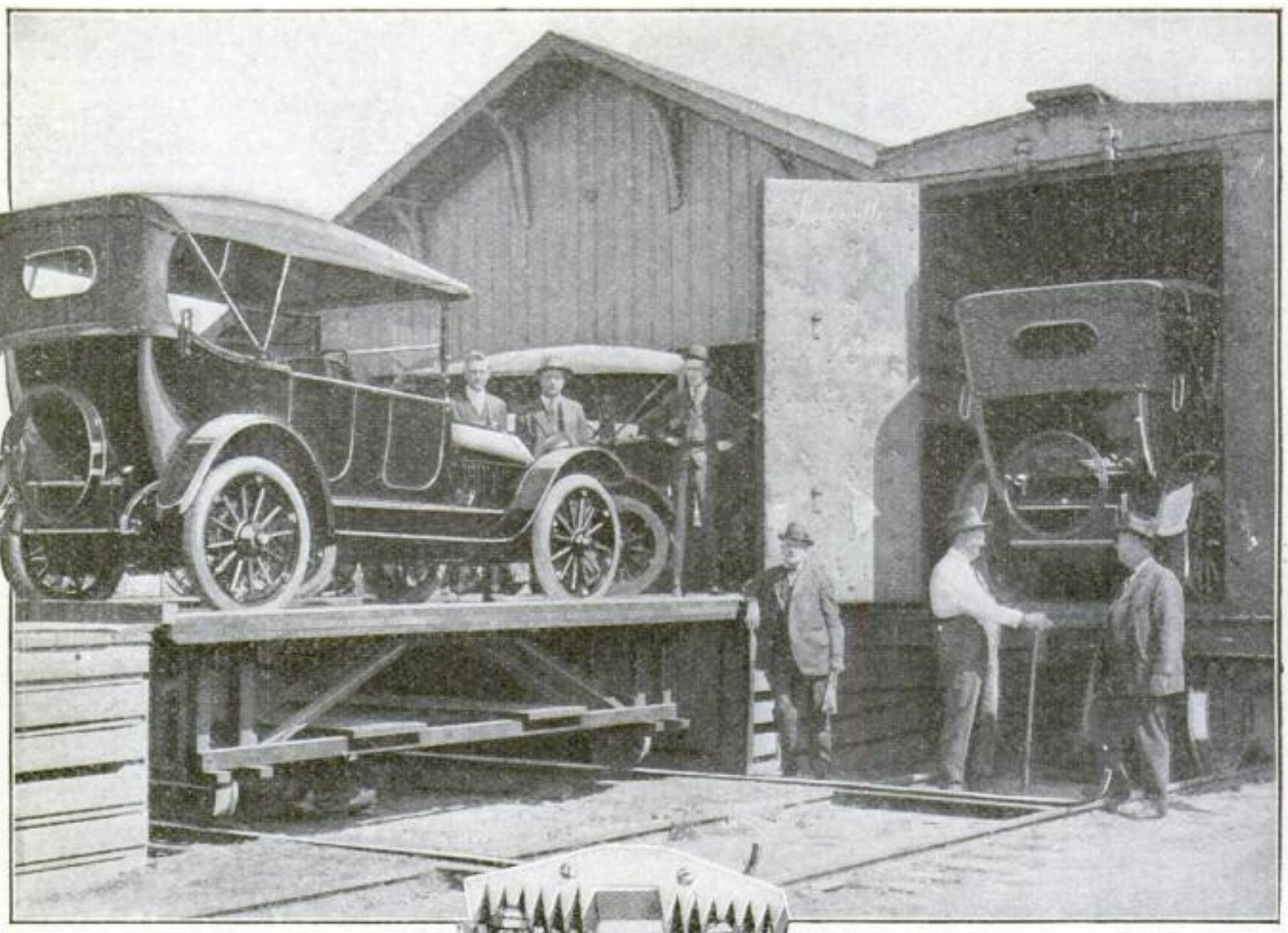
At left: An adjustable accelerator heel-rest is one of the newer refinements introduced by an inventor

Above: Storage-battery tractor drawing trailer-trucks in a freight-transfer station. Each tractor can handle at least 180 tons of material each working day

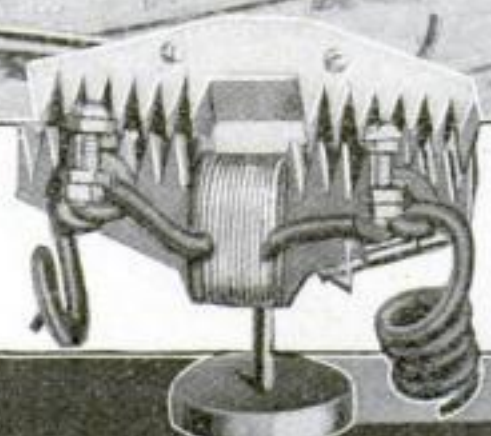
At right: A four-wheel drive automobile comes to the rescue of a marooned truck in Mexico. It pulled its load through fifteen miles of adobe mud without trouble



Here Are Some More Practical Ideas Designed to

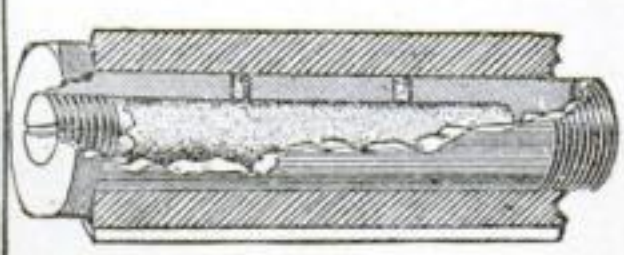


Above: Removing automobiles from box-cars with a movable platform which ordinarily remains a part of the warehouse



At left: Controling Ford lights by a reactance-coil with a variable gap in its magnetic circuit to regulate the current

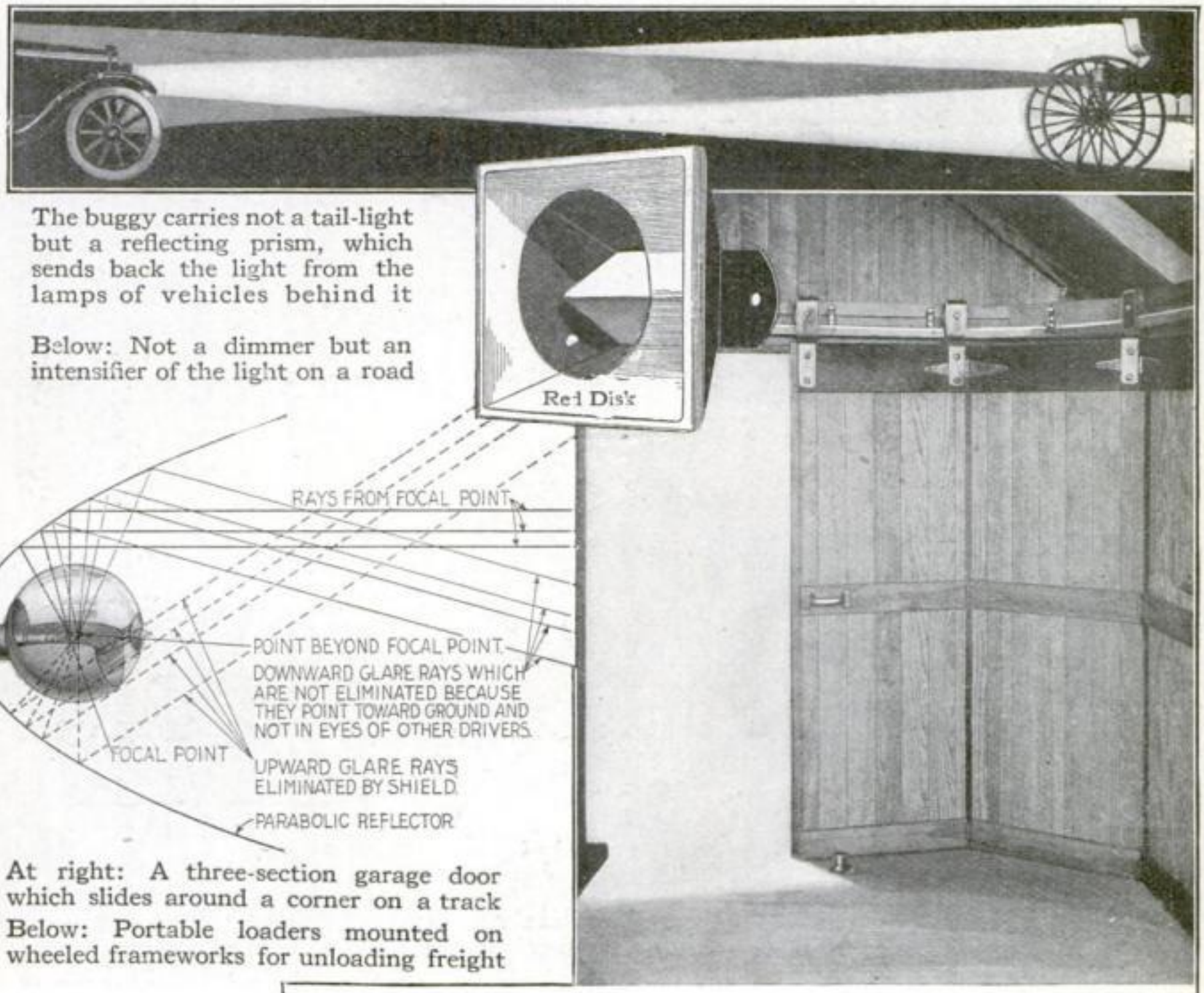
Above: A two-light bulb case in a steel cylindrical tube is handy when locating trouble



Above: A lubricating-bolt with an oil-soaked wick automatically lubricates parts which slide over each other

At left: The speedy sidecar motorcycle fire apparatus, equipped with chemical extinguishers, lanterns, axes and other emergency tools is appearing in our more progressive rural communities

Increase the Usefulness of the Motor Vehicle



The buggy carries not a tail-light but a reflecting prism, which sends back the light from the lamps of vehicles behind it

Below: Not a dimmer but an intensifier of the light on a road

At right: A three-section garage door which slides around a corner on a track

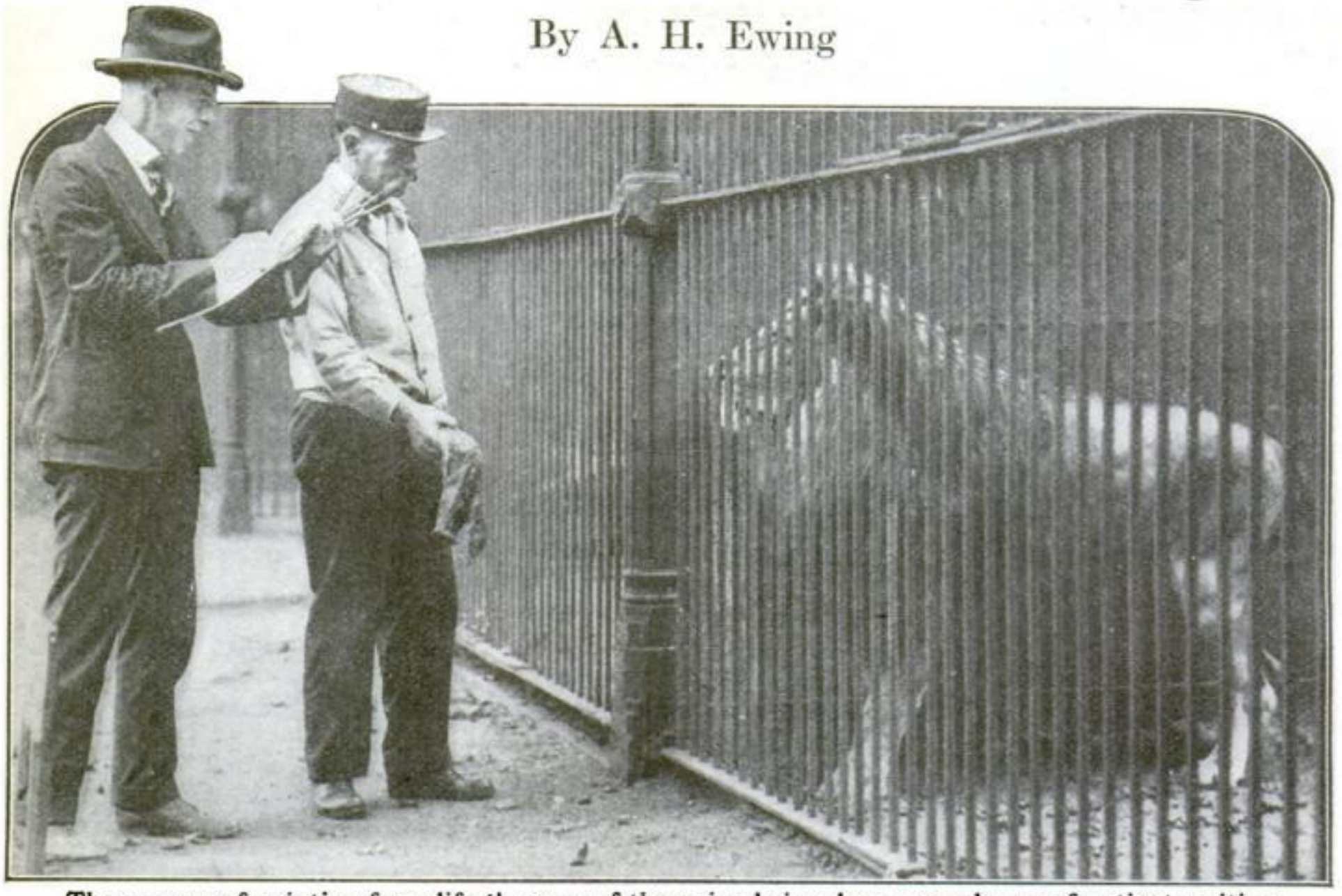
Below: Portable loaders mounted on wheeled frameworks for unloading freight

Below: A grease and oil gun that requires no screwing, air pockets or paddles. The gun is loaded by removing the lower cap and filling it

Painting Wild Animals' Eyes

It is the natural expression, not the hypnotic stare that is sought

By A. H. Ewing



The process of painting from life the eyes of the animals involves many hours of patient waiting in the effort to catch and hold the gaze of the restless, indifferent or resentful imprisoned beasts

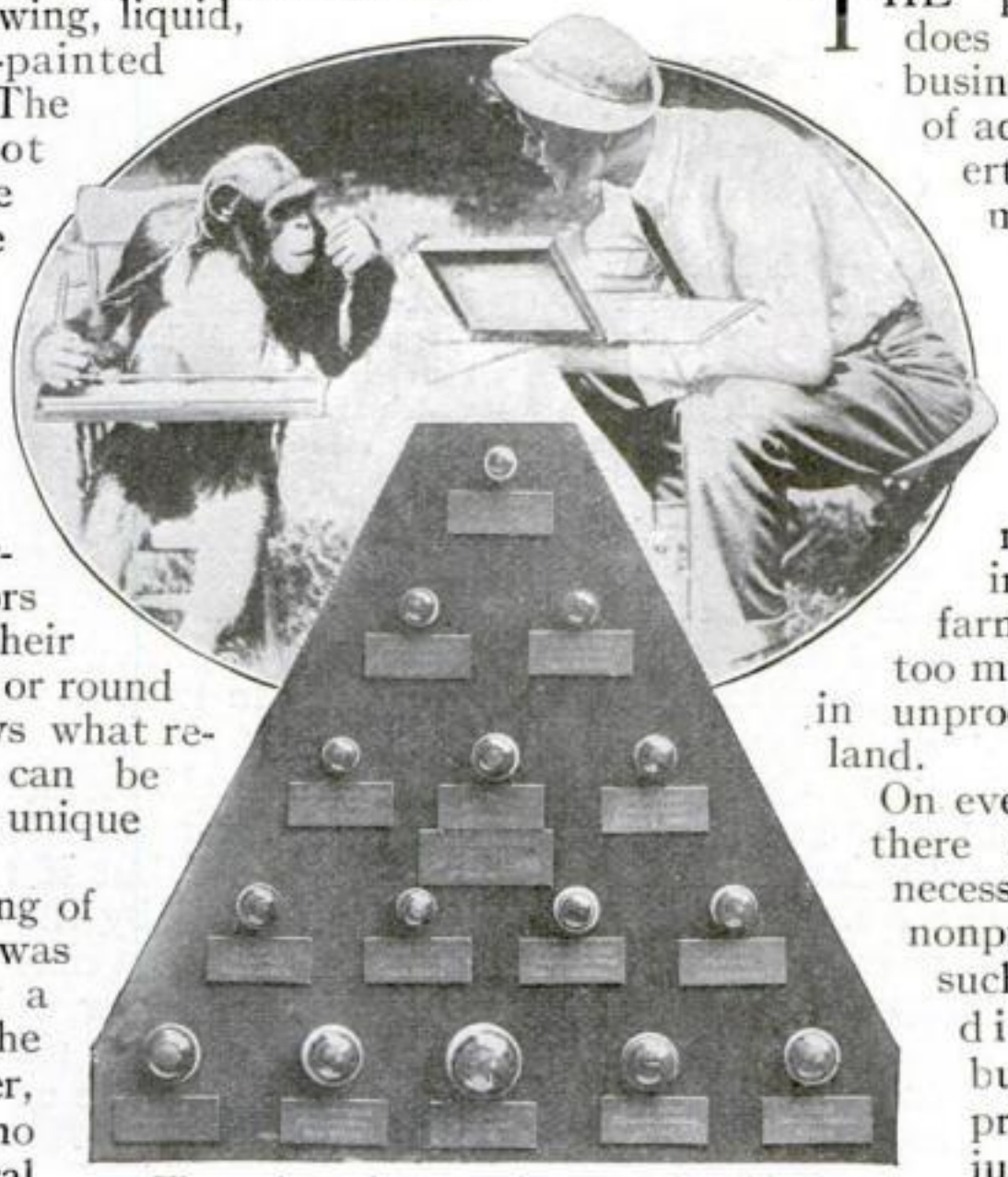
NOW that taxidermy has become an elaborate art, the sportsman and the museums alike demand an absolutely life-like aspect in a "mounted" specimen. Mr. Wilson Potter of Philadelphia, hunter of big game and taxidermist, has an entire building in the city fitted up with every appliance for perfecting the art of modelling and mounting his trophies of the hunt. An expert sculptor and an equally expert taxidermist are at work in the shops, and the truly marvelous result of their work is shown in the museum, at the Broad Street front of the building. Despite the high grade of the work, however, Mr. Potter decided, a few seasons ago, that even the best workmanship left much to be desired in the finished effect, so long as the eyes supplied by manufacturers were used. The camera did not aid him, and so Mr. Potter looked about for an artist who could reproduce the vast differences in the eyes of the various species of animals, and the shape, color, size and expression of each, as well as catch an expression to suit any pose which might be chosen for a "mounting."

David Finkelgreen, a Philadelphia artist, undertook to give Mr. Potter exactly what he wanted. When not engaged in his winter presidency and directorship of the Graphic Art Club, Mr. Finkelgreen went far to make a careful study of wild animals' eyes, often under difficult and dangerous circumstances; he also dissected eyes of animals which had been shot in the chase. His work in the Zoological Gardens, painting eyes of the animals in cages, aided him much in perfecting the art of reproducing the eye with his brush. The process called for many hours of patient waiting and effort to catch and hold the gaze of a restless, indifferent, or resentful beast long enough to bring it to the hypnotic stage when the painting could be done. Holding a box of paints in his left hand, the artist paints in the cup-like inside of a crystal mold, always allowing for the difference in effect made later by the upper covering of crystal when the eye reaches completion.

The artist continued his efforts until he became the foremost painter of animals' eyes in the world. It is easy to realize this

when one turns, with relief and pleasure, from the case of manufactured eyes, shown in the showroom of Mr. Potter's building, to the case of glowing, liquid, or gem-like hand-painted representations. The experience does not only enlighten one as to the wide range of differences in the eyes of various kinds of beasts, in the marking, rim, shape, size, coloring and expression, and particularly in the colors of the pupils and their curve-like, slit-like or round shapes; it also shows what remarkable results can be obtained in this unique phase of fine art.

And the perfecting of this phase of art was made possible by a determination on the part of Mr. Potter, which stopped at no expense, from several dollars apiece for the imported crystal molds from England, to financing long trips, and engaging the best artist obtainable—in this case, Mr. Finkelgreen.



The artist paints on the crystal molds the exact coloring, shape, size and expression of the eyes of the different animals. A crystal covering completes the eyes which are then labeled and filed in cases

Warning Herdsmen of the Approach of "Untempered" Storms

THROUGHOUT the Northwest, where sheep-raising is one of the principal industries and where the weather is not always tempered to the shorn lamb, for the simple reason that shearing and lambing are scheduled for the very early spring, the loss to the herders from deaths, due to exposure in sudden storms, sometimes totals fifty per cent of the flocks.

For this reason, during the Spring of 1916 the Weather Bureau installed a special storm-warning service for Oregon, Washington and Idaho sheep ranges. The service was operated through twenty-five distributing centers. Special reports and warnings were sent out, covering temperature, rain, snow, winds, clouds and a clear sky. The messages were passed along by telephone and reached stockmen by noon or earlier of the date of issue.

Are You Paying for Your Farm or Is It Paying for Itself?

THE progressive farmer does not measure his business by the number of acres which his property embraces; for in many instances it is the man who does an intensive business on a comparatively small acreage who makes the most money out of farming. Usually the farmer has altogether too much money tied up in unproductive, or loafer, land.

On every farm, of course, there are certain areas necessarily devoted to nonproductive purposes, such as fence lines, ditches, lanes and building lots. The problem is to decide just how great a percentage of the aggregate land may be devoted to such uses profitably, or at least without detracting from the yielding capacity of the farm. For instance, untrimmed hedges, fences, or zigzag rail or worm fences require more than twice as much land as woven wire or barbed wire fences.

Similarly, a little planning may result in the elimination of farm lanes by a simple arrangement of fields; and a compact grouping of the farm buildings, with due regard for hygiene and attractiveness, may restore a considerable portion of the nonproductive acreage to the profitable class.

Some areas are hopeless, but before being pronounced entirely unreclaimable their possibilities should be considered from every angle. Many untillable fields make productive pasture lands, or they can be used for the production of timber. On the other hand it may be an advantage to clear and till wooded acreage, first counting the cost of the work and balancing it against the sale price of the timber products, the increased value of the land and the added expense of firewood after the timber has been disposed of.

Renovating the Old Golf Ball

Perhaps this is the great bonanza of which the caddies are dreaming

The ball is forced between the two spring-holders on the cover of one of the paint pots and is lightly impaled on the center pin

The cover of the can becomes the holder for dipping the ball into the enamel, after which it is screwed back into position

WHEN the golf ball loses its original good looks and the paint begins to chip off and crack, it is thenceforth regarded as practically worthless for a good game. But a ball which has been coated with enamel paint may be cleaned and painted again, making it as good as new.

A kit for cleaning and painting the balls consists of two cans, one No. 2, for holding sufficient enamel paint to cover fifty balls, and one No. 1, for a supply of paint remover, of which three bottles will be required. One bottle of enamel should also be included in the equipment. A device for holding the balls during the dipping and drying process has been invented by G. H. Lambert, of Asheville, N. C. It consists of two spring-holders and a central pin which fastens to the top of the can.

The ball to be renovated is first washed and dried and the old paint thoroughly removed. Then it is forced between the two spring-holders on the cover so that it is lightly impaled on the center pin. It is then dipped into the enamel, withdrawn and the cover reversed and screwed on the can, leaving the ball in its position on the center pin until it is perfectly dry.

In about two hours it will be dry enough to handle and in about six or eight hours it may be used again in the game.

Care should be taken that the ball is entirely covered when it is dipped in the enamel. When it is withdrawn from the enamel-bath it should be held over the can containing the enamel until the surplus paint has drained off. This is a matter of economy as well as cleanliness. The cover should be replaced quickly over the enamel-can to keep the air from the contents.

As the enamel becomes used up, the ball may not be entirely coated by just dipping it into the can, but if the cover is held securely in place by the thumb of one or both hands, the can may be tilted and the enamel splashed over the ball by shaking the can from side to side. If the enamel becomes too thick the enamel-thinner may be added. This should be stirred in thoroughly, good judgment being used to get just the right consistency. If too much of the thinner should be used and one coating of enamel should not give satisfactory results the ball should be redipped, but it should first be reversed to insure an even coating.

The cigar-shaped bubble-blower is filled like a fountain pen, and it will blow innumerable bubbles

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Johnny Blows Bubbles from His Toy Cigar

A BUBBLE-BLOWER that is shaped like a cigar and that fills like a fountain pen eliminates the muss and trouble encountered with the common blower. After the little vial shown in the illustration is partly filled, hundreds of bubbles may be blown without further trouble. The blower is a source of great amusement to children, and mothers like it because it does not drip the suds. The youngsters will doubtless regard it as being as superior to the ordinary bubble-blower as a Perfecto is to a pipe.

Indoor Tomato Plants Fifteen Feet High

TOMATO vines thirteen feet tall may sometimes be grown in a garden, but as far as investigations have shown that is the limit. A few years ago a large field of tomato plants of that height was grown in Charleston, West Virginia, but two workmen in a factory in Glenbrook, Connecticut, have recently excelled this. They have grown one plant on a trellis, from which the tomatoes could be picked at a height considerably above one's head, and the actual length of the vine reached fifteen feet.

Tomatoes occasionally emphasize their vine-like characteristics, probably more frequently within doors than out of doors.

A tomato plant grown in a window-box. The plant attained a height of fifteen feet and bore abundant fruit

To produce tall tomato plants in any place, pinch off or cut off the seed pods. All the energy of the tomato is then transferred into the terminal. The same principle may be applied to any tree. Small trees, such as willows and maples, if trimmed too much on the side will soar so high and become so slender that they will go over to the ground—top-heavy, as the forester would call it.

The species of tomato which usually grow to great height are the small kinds. The fruit grows in great profusion, and is so attractive in appearance that in many localities the vines are grown for decorative purposes. It was the small red variety which was formerly called the "love-apple" and was cultivated for its beauty long before it was known as an edible fruit.

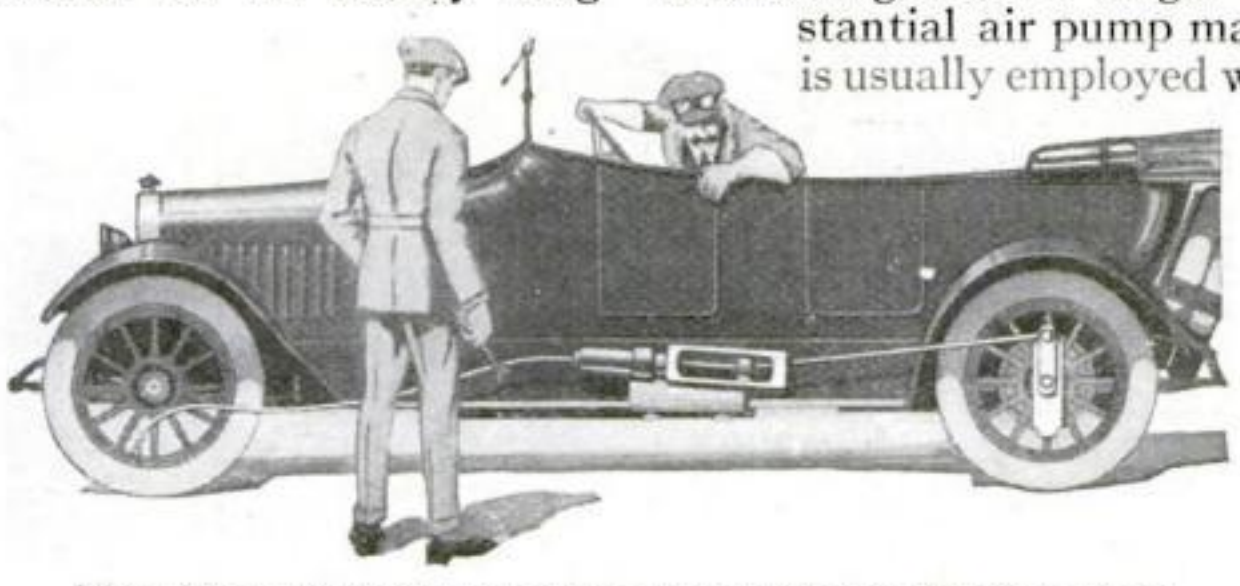
These plants with their profusion of dark foliage, if trained over wire netting, make good garden fences where space is valuable.

Valuable Products May Be Obtained from Cherry Pits

SIXTEEN hundred tons of cherry pits, now a source of annoyance and expense to canneries, can be made to yield two valuable oils and also a meal for feeding cattle, according to specialists of the U. S. Department of Agriculture. In addition the 105,000 gallons of cherry juice now wasted in seeding cherries can be turned into desirable jelly and syrup, or even into alcohol. A saving of these valuable by-products from cherry canning may make possible the domestic manufacture of substitutes for almond oil and bitter almond oil, now imported, and at the same time establish a new industry in the cherry packing districts of the North Atlantic, North Central, and Western States.

An Automobile-Pump Driven from the Rear Wheel

FOR pumping up automobile tires by the power of the motor, the usual practice is to mount the pump along with the motor on the front of the car; but this has the drawback that the pump can never be removed to be used on another car. A new idea which is shown in operation in the illustration below employs a separate pump and has fittings for placing it on the side of the car. The piston of the pump is driven by a rod from the rear wheel of the car by the use of a special piece which is readily clamped on the wheel. By this arrangement a larger and more substantial air pump may be used than is usually employed where the installation is permanent. This of course means more rapid and efficient work, which implies a saving in valuable time, temper and patience for automobilists.



The piston of the pump is driven by a rod from the rear wheel by means of a special member clamped on the wheel

What? Tail-Lights for Mules! Yes, Here They Are

Above: How the tail-lights assist the mule-driver behind his pack train. At right: The light attached to the tail

THE mule, the most used and abused of pack animals, doesn't know much about hitching his wagon to a star, but inventive man has come along and has hitched a star to the mule's tail. All this has been done to protect the mule's life, and to prevent him from losing himself and making trouble when he is but one mule in a drove of mules.

Recently a disastrous accident occurred near Los Angeles when a woman driving an automobile along the highway ran into a drove of mules. The automobile was wrecked, the woman was injured, and two of the mules were killed. A court action was later filed against the owner of the mules, and the woman was awarded substantial damages.

It would seem at first thought that the owner of the mules rather than the automobilist was entitled to damages; but the judge must have known something about mules and understood the odds.

As a result of the accident the mule owner devised a tail-light to be worn by his animals after dark. It is a light of the simple reflectoscope type, such as is used by bicyclists. When a pack train of mules is driven along at night each mule is adorned with a light. This enables the driver, far in the rear of the lead mule, to note the position of each animal in line and the direction he is taking.

The Tiniest Motorcycle To Be Used in the Army

SOME interesting experiments were made recently by Captain Frank E. Evans of the United States Marine Corps with a view toward establishing the practicability of a small motorcycle designed by Hugo C. Gibson.

A private, equipped in heavy marching order, tried out the machine. He had had no previous experience with automobiles or motorcycles. Yet his success in operating it has led to the belief that it would be a welcome addition to the fighting equipment of our soldiers.

The machine will carry as much as three hundred pounds and attain a speed of twenty-five miles an hour, although its weight is but fifty pounds. It takes hills easily. Private Davis, who tried it out, found no difficulty in ascending a fourteen-degree incline.

The machine is so small that it will turn around sharp corners without danger. It is so light that it may be lifted over any ordinary obstacle. One of the tests consisted in riding it up to a four-foot fence, stopping the engine and lifting the machine over the fence, all of which was done with very little delay. If the man who delivered the famous message to Garcia had had one of these his task would have been easier.

The dimensions of the little machine are forty-eight inches by nine inches by eighteen inches. It is almost small enough to be a plaything. Yet it will carry three hundred pounds for fifty miles at an operating expense of ten cents.

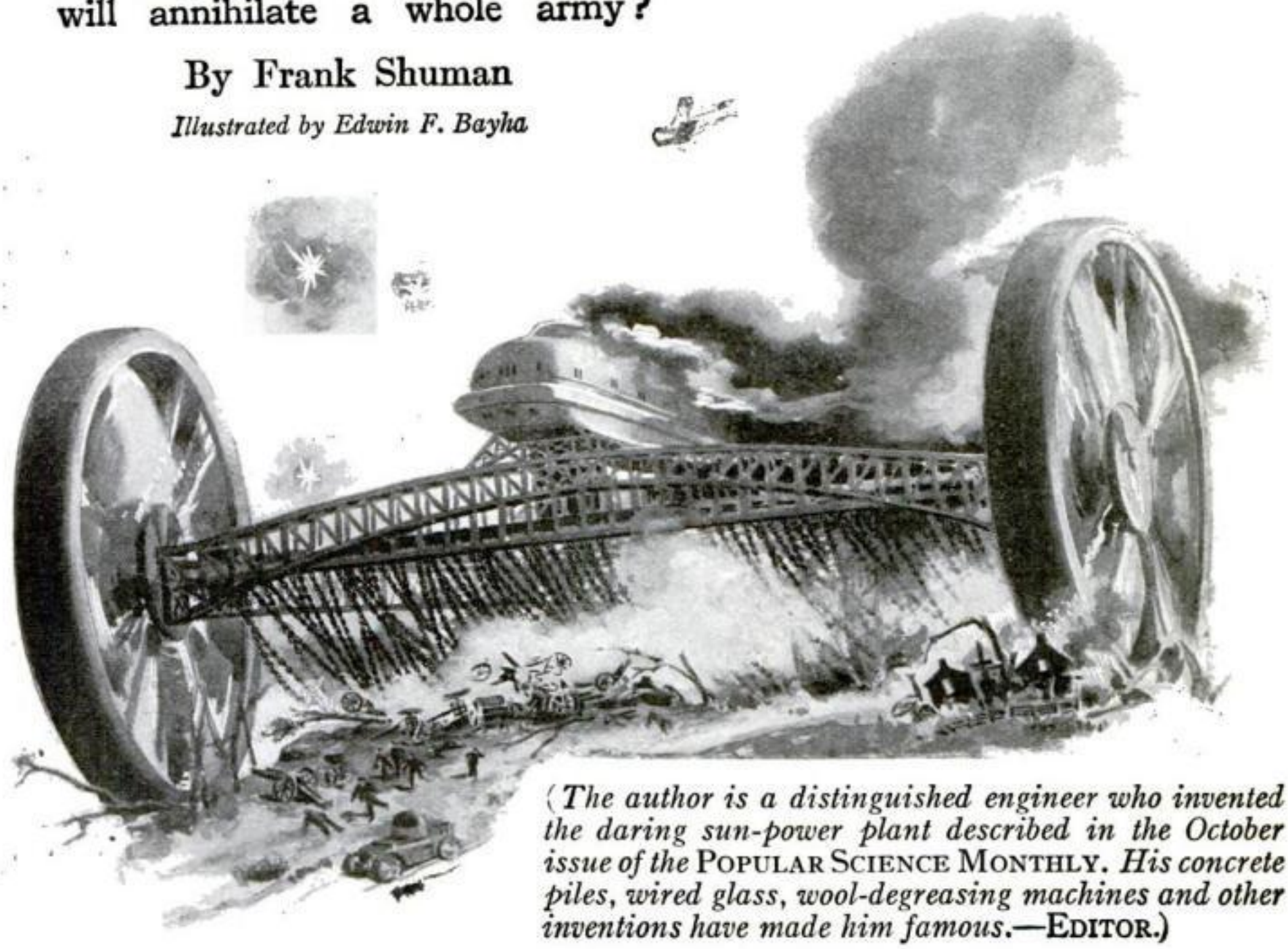
It looks tiny, but it will carry three hundred pounds at twenty-five miles an hour

The Giant Destroyer of the Future

Can a juggernaut be built which will annihilate a whole army?

By Frank Shuman

Illustrated by Edwin F. Bayha



(The author is a distinguished engineer who invented the daring sun-power plant described in the October issue of the POPULAR SCIENCE MONTHLY. *His concrete piles, wired glass, wool-degreasing machines and other inventions have made him famous.—*EDITOR.)

A CLUB, a bow and arrow, a blunderbuss, an infantryman's rifle, a forty-two centimeter howitzer are merely instruments for delivering blows. The essential difference between the battles of prehistoric times and those of today lies in the manner of delivering blows. Smokeless powder has merely lengthened the arm of a modern fighter. He strikes and kills at a distance of miles.

For all our machine-guns, for all our terrible "artillery preparation," battles are still won by bayonets. Tactics have been somewhat modified since Napoleon's day, because of the invention of the machine-gun and the high-powered field-piece. But the individual fighter is still as important as he ever was. We speak of the German or French or Russian "war machine," when we mean a million or more individuals trained to act with a precision that roughly approximates that of a modern university football team.

Only the Battleship Is a Real War Machine

Because armies are still composed essentially of many individuals, fighting ships may be more fittingly termed "war machines." A modern battleship is a real machine. The men on board are merely so many intelligences that control the steam-engines, the turrets, the great guns, the searchlights. No one ever hears now of hand to hand conflicts at sea. Ships are sunk at ranges of five and seven miles. But land warfare is still waged not by a few machines, as on the sea, but by organized millions of men.

Armies have increased in size. Fighting ships, on the other hand, have diminished in number. Contrast the numerical strength of the British Navy now with what it was in the days of Drake and Nelson. A few dozen ships, highly intricate machines, have taken the place of hundreds.

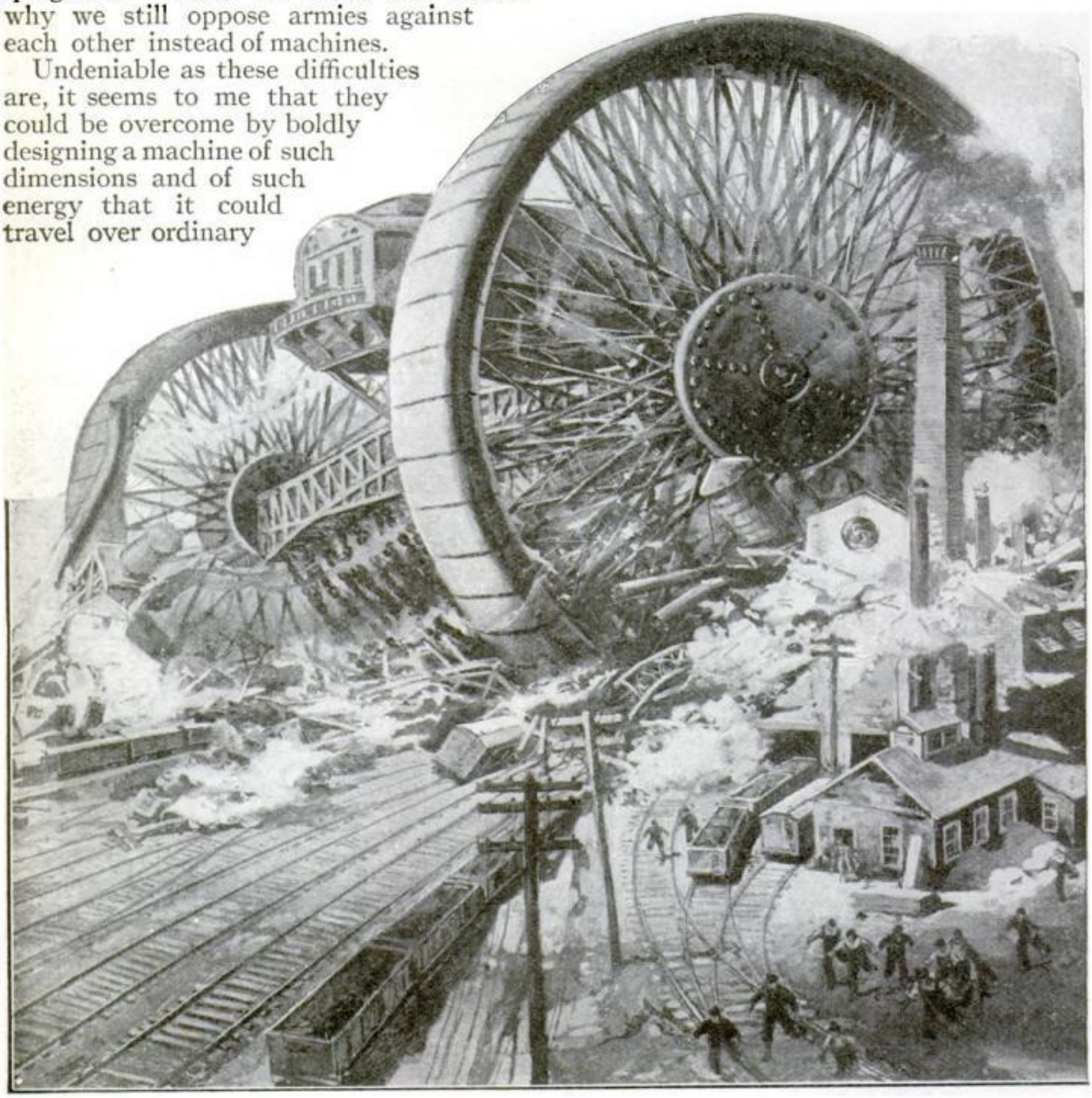
Why is there no land battleship, something comparable with our own *Penn-*

sylvania, something which will concentrate within one volume the striking power of an army?

Why Not a Battleship On Land?

There is no good engineering reason why an enormous wheeled structure, heavily armored and capable of traveling at high speed should not wage the battles of the future. Technically, it is a far easier task to design and build a super-dreadnought than a wheeled destroyer to run on solid ground. The ocean is a vast, level expanse. There are no hills and valleys. Water is the same in density everywhere. But land varies from the hardest rock to the softest quagmire. Here we have the reason why we still oppose armies against each other instead of machines.

Undeniable as these difficulties are, it seems to me that they could be overcome by boldly designing a machine of such dimensions and of such energy that it could travel over ordinary land much as an automobile travels over a country road. A hill fifty feet high would be to that machine what a six-inch ridge of clay would be to an automobile; a swamp would no more hinder its course than half a foot of mud would stop a touring car. Its speed would be at least one hundred miles an hour on the long, level, sandy beaches along our coasts. And even over rough inland country it would rush far more swiftly than any touring car on a poor road. Indeed, in its speed would lie its destructive possibilities. The impact of a heavy mass moving with the velocity of an express train would be irresistible. It could mow down everything before it with the relent-



The machine proposed by Mr. Shuman would be irresistible. With its front wheels measuring 200 feet in diameter, and the weights aggregating many tons dangling down in front from chains,

lessness of a steam-roller. Guns would not be required to rout an enemy. An army would be as helpless in offering resistance as a flock of geese in the path of an automobile.

A Giant Three-Wheeled Armored Car

It is impossible within the limits of a short article to describe this machine which I have conceived in all its details. Picture to yourself, however, a self-propelled machine, comprising three wheels and a heavily armored body or car. There are two wheels, one hundred and fifty to two hundred feet in diameter in front, and a single smaller steering-wheel in the rear. The entire structure is short, so that the turning radius will be small.

No doubt you are familiar with the military masts of our American battleships. They are latticed towers, not unlike cages. They are thus constructed so that whole sections of the lattice work may be shot away; but the remaining portions will still support the mast.

So I would build the wheels of my war machine. Why not armor them instead? They would weigh far too much—thousands of tons in fact. But the hub I would armor—and heavily. There the spokes would be concentrated so thickly that they might be shot away in great numbers. Besides, the hub and axle must be well protected. Therefore the center of each wheel would be a mass of armor as thick as that of a battle cruiser.

The two front wheels of this war machine

it would plow through a whole town, blotting it out of existence as if it were a mere ant-heap. The wheels would be latticed, so that shot might pass through without destroying them

Ordinary rivers and marshes would not stop the machine. Few rivers are more than fifty feet deep. The 200-foot wheels of the machine would dash through them as easily as an automobile through a pool of mud

would have to be spaced about three hundred feet apart. They would have a tread about twenty feet wide,—in other words, about as wide as an ordinary room. I would make them of steel plates four inches thick, bolted together in sections.

Since the machine is to destroy by virtue of its inherent energy and not by means of guns, it would have a comparatively small car—a car which would not rise above the tops of the front wheels, which would be heavily armored, and which would serve primarily as a housing for the engines. The crew would be small—not more than perhaps thirty men.

I am fully aware that the problem of obtaining engines which will give this war machine a speed of one hundred miles an hour is not easily solved. But if thousands of horsepower can be developed by the engines of pitching and rolling battleships it is not unreasonable to suppose that competent engineers can be found to design and build steam engines of twenty thousand horsepower, fed by oil-fired boilers.

Once more let me state that the front wheels are one hundred and fifty to two hundred feet in diameter. Hence, they would make less than fifteen turns to the mile.

How Shocks Would Be Absorbed

That simplifies the matter of absorbing shocks. If a racing automobile on a fine track leaps into the air when it strikes even a pebble, simply because the spring suspension has not time to respond to the shock, it is obvious that the huge structure that I have in mind must be provided with inordinately strong yet sufficiently sensitive shock-absorbers. The shock that would be experienced in knocking down a small factory building, would certainly not be as great as the shock that must be absorbed as a modern fifteen-inch naval gun suddenly recoils after discharge. If cylinders filled with oil can check the terrific recoil of a big gun, they can also act as shock-absorbers on a land war machine. And so they can be imagined on the machine—huge cylinders, three feet in diameter, filled with oil which would resist the pressure of pistons on the axle.

The weight of the entire structure would be probably five thousand tons. Since the machine is to batter down everything in its path, there are to be suspended from the front of the machine a series of heavy weights, each weighing several tons. The weights may be raised or lowered. When dropped into position their impact at high speed would level everything before them.

Only Big Guns Could Stop the Machine

Terrible as this contrivance would be, it would not be able to withstand bombardment by 16-inch Skoda or Krupp guns. It is not intended for that. Ordinary field artillery will not stop it. Its sole purpose is to move up and down an enemy's country, to make a whole region untenable, to crush down resistance offered by ordinary field fortifications. Mines will be planted to blow up the destroyer. Mines do not prevent a battleship from venturing upon the sea. Moreover, the maneuvering power of the land war machine will be such that it may change its course wilfully with such rapidity that a whole countryside would have to be blown up in order to affect it.

Imagine yourself standing at one front wheel of this machine. Comparatively you would be no bigger than a baby standing beside the driving wheel of a passenger locomotive. Far above you would be the maze of spokes constituting the latticed wheel. Perched midway between the two gigantic front wheels, as tall as many a moderate sized office building, would be the ship-shaped armored car for the engines and the crew. You reach it by means of an elevator resembling that in which miners rise from deep coal mines. Once in the car, you might fancy yourself in the engine room of a ship; there is no difference so far as general appearances go. With the commander you step into the conning-tower—a circular, armored chamber well forward, dominating the entire landscape.

The commander gives a signal. The machine moves. It gains headway. Soon it travels at express-train speed. A mile ahead is a densely wooded park. In a minute the machine reaches it. Does it stop or swerve? It plunges on. Trees are crunched as if they are mere weeds. You look back in the wake of the machine. It is as if a storm had laid low every poplar and elm. And yet the machine is not even scratched. An enemy village, occupied by enemy soldiers lies in front. The machine speeds on toward it. It reaches them. Houses are battered down as if they were made of paper. Wherever the weights that dangle down in front strike, wherever the wheels move, there is a rending and a crushing. And so, everything is leveled before the war machine—walls of earth or masonry, houses big and little, railway stations and signal bridges.

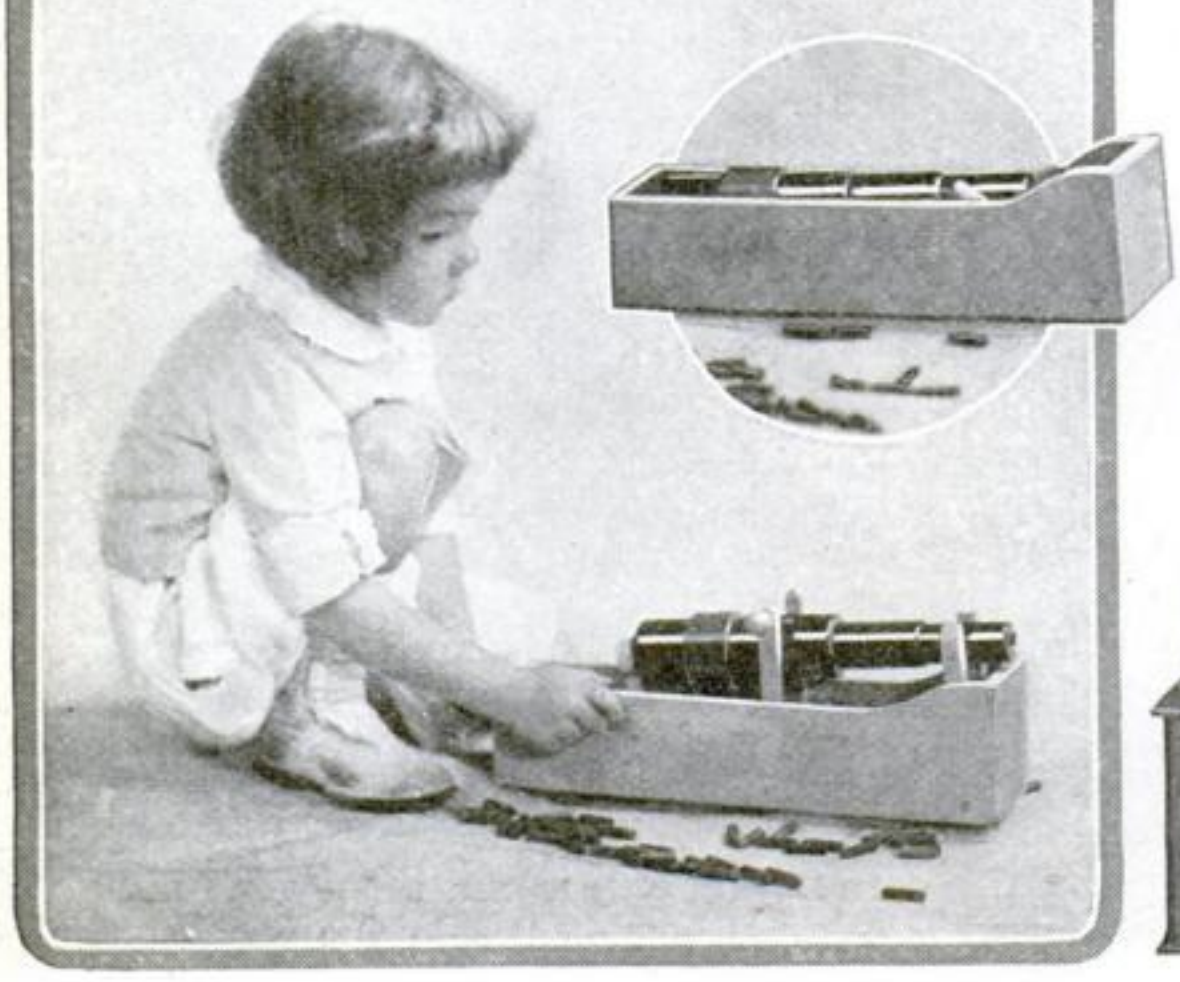
Old Favorites Modernized and Made to Express

Active children are likely to tire of a hobby horse that does not really travel. This one is mounted on wheels like a tricycle, the pedal being fastened to the front wheel and the handlebars to the head of the horse

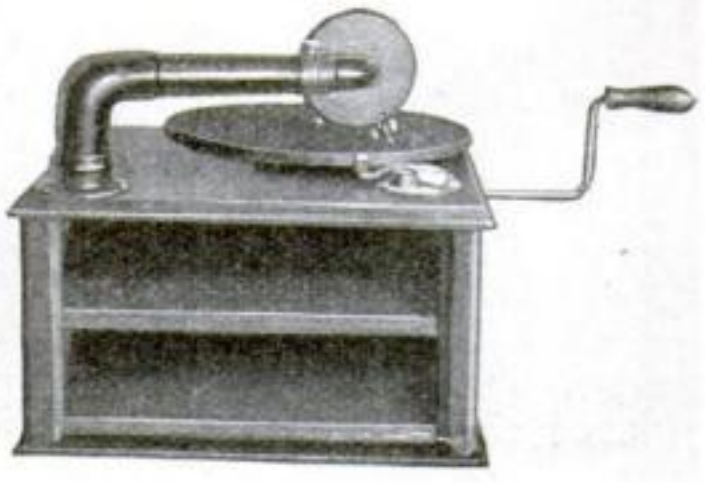
Pierrot will begin at one end of the parallel bars and turn somersaults all the way across to the other end and then back again

Give a little jerk to Bruin's chain and he will dance and perform the tricks of a real, live, lumbering circus bear

At left: A miniature gun which demolishes the enemy and then sinks down out of sight behind the breastworks. It is modeled after our disappearing coast defense guns



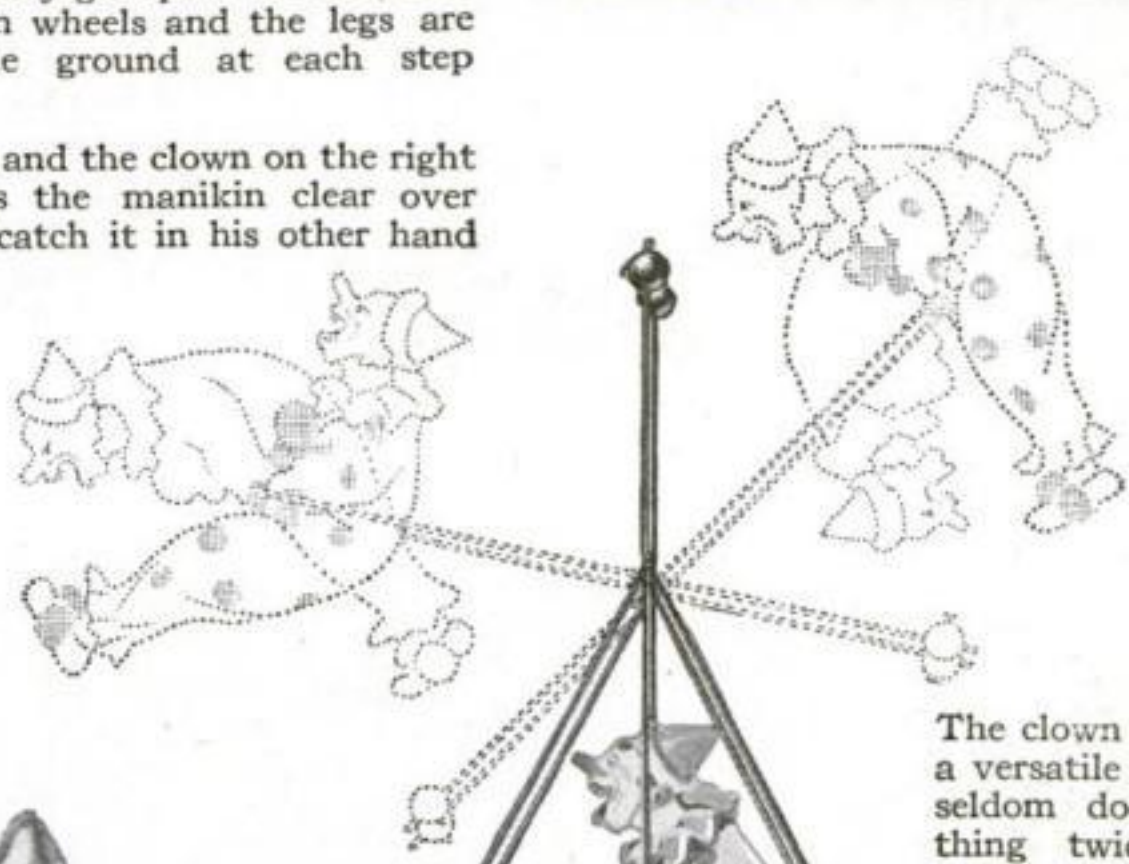
The toy phonograph below is so strongly constructed that even a destructive child could not readily get it out of gear. It will play regular records of larger machines or small ones



Action Often Prove the Most Popular of Toys

This horse actually gallops. The four feet are mounted on wheels and the legs are lifted from the ground at each step

Pull the string, and the clown on the right above will toss the manikin clear over his head and catch it in his other hand



The clown on the left is a versatile acrobat. He seldom does the same thing twice but will swing on a horizontal bar, turn somersaults forward and backward, and sometimes swing all the way over the two balls at the top of the tall scaffolding

How Inventors Are Meeting Young America's

When the handle of the toy above is pulled the three figures on the merry-go-'round revolve

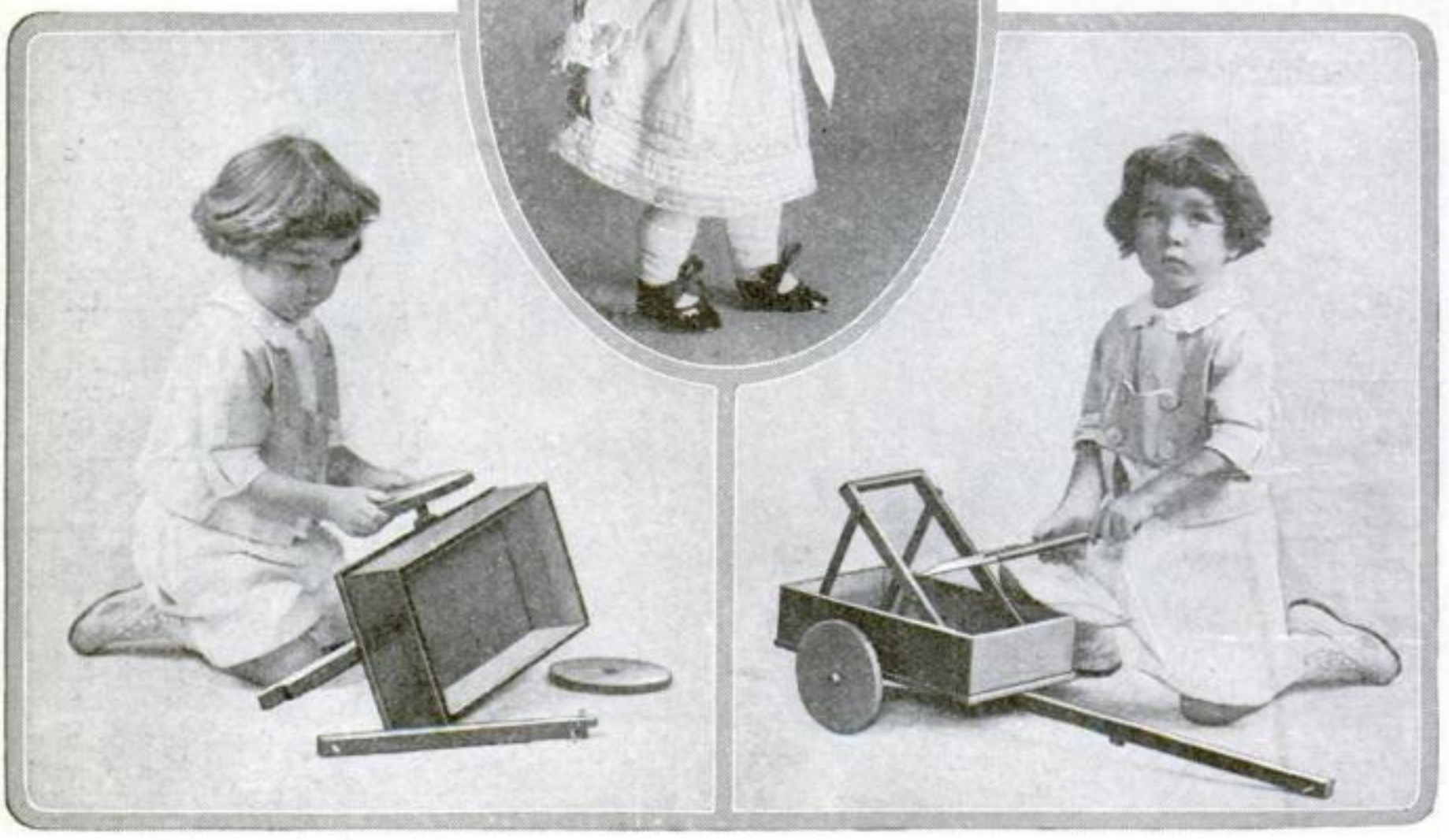
Place these two little figures on the edge of the table and tap the table. They will engage in a lively dance Their action depends on a spring and ball-bearings

Under his Oriental robe the little Japanese carries a mechanism which enables him, when wound up, to walk sedately and draw after him the beautiful lady in the cart, who waves her hands about in a very animated fashion in appreciation of the ride

In oval below: When you take this little doll by the hand she will walk with you in a remarkably natural manner, provided you wind her up first. She uses the joints both of her knees and her ankles

Below: A wheelbarrow which may be taken apart and put together again will teach the child the construction of the toy

Below: A sand cart equipped with a sifter and shovel. This cart, too, may be taken apart and may be packed away in the cart-body



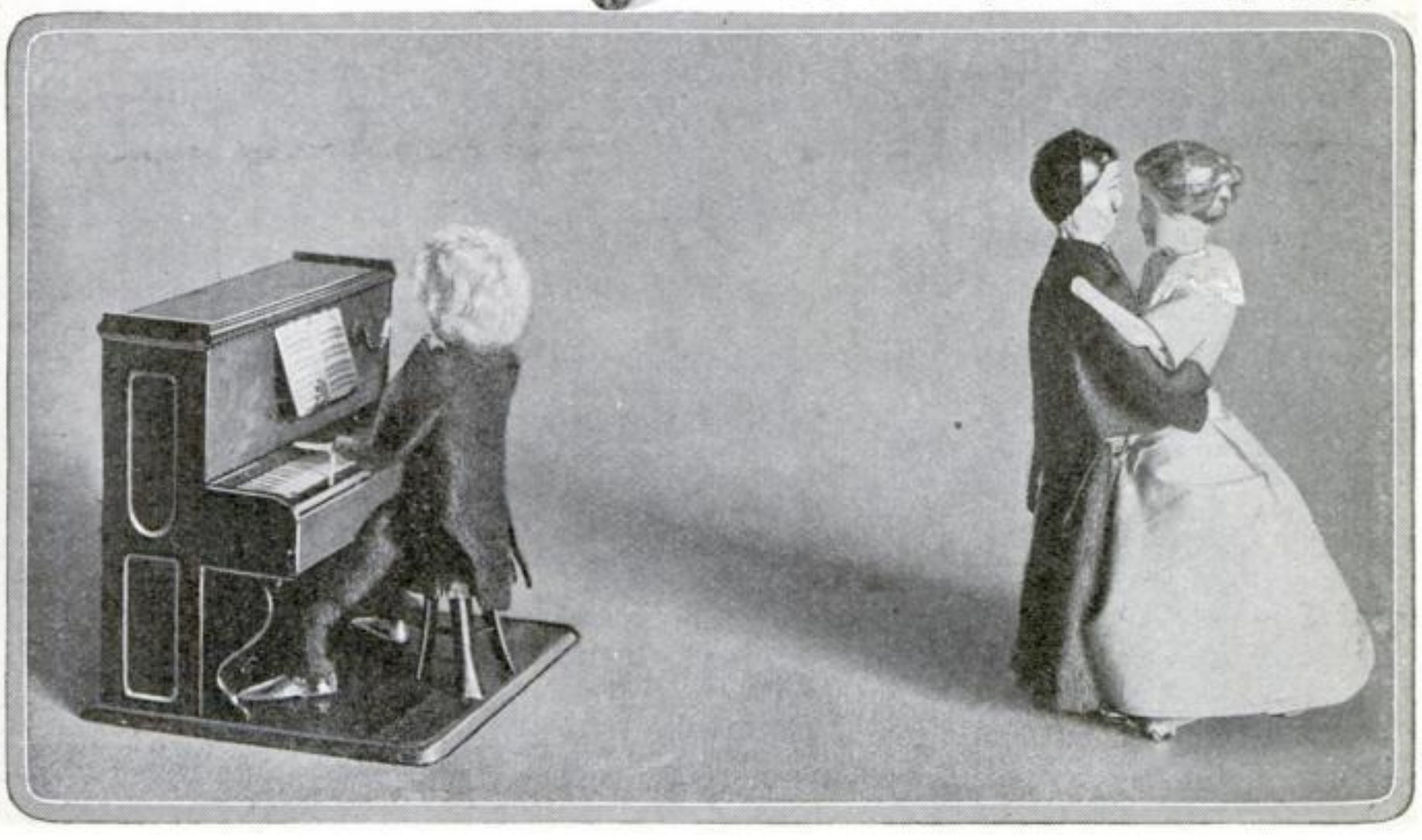
Imperious Demand for a Variety of Animated Toys

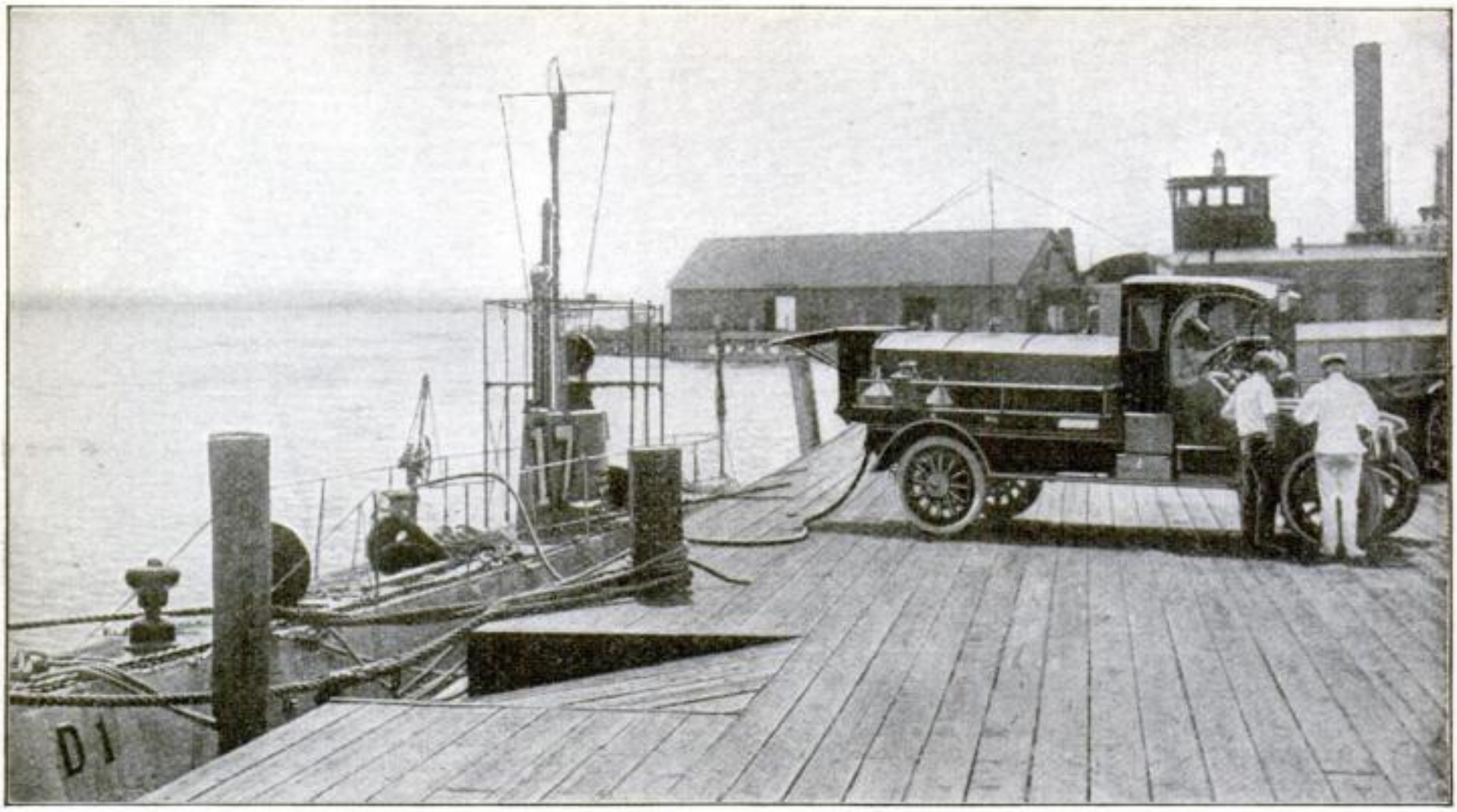
The pairs of rockers on the front and the back legs of this charger move independently of each other and the horse can be made to travel all around a room

A toy outfit which teaches the A, B, C of electricity. The motor can be taken apart and reassembled and will furnish a small amount of power to operate other toys

The little dachshund below will be so pleased to follow where his master may lead him that he will wag his tail and wiggle all over. He moves on ball bearings

The pianist below shrugs his shoulders and sways to the rhythm of the music he makes, while the dancers waltz merrily around. They are operated by springs





A tank truck at the dock at New London, Conn., delivering fuel to the United States submarine D-1, shortly before the submersible left port to participate in the maneuvers of the Atlantic Squadron

Gasoline Tank-Trucks as Tenders to Our Submarines

LARGE fleets of tank trucks operated by the various oil companies are proving valuable adjuncts to the United States Navy in supplying oils and gasoline to submarines, hydroplanes and other types of naval vessels along the Atlantic and Pacific coasts.

The speed of the trucks is important in delivering vast quantities of fuel, thus making it unnecessary for naval craft to lie at the docks for long periods awaiting the arrival of these highly essential supplies. The great capacities of the tank trucks permit the oil companies to deliver large quantities of oil and gasoline in one haul. On arriving at the dock, a long section of rubber hose is used to transfer the load direct to the fuel compartments of the vessel.

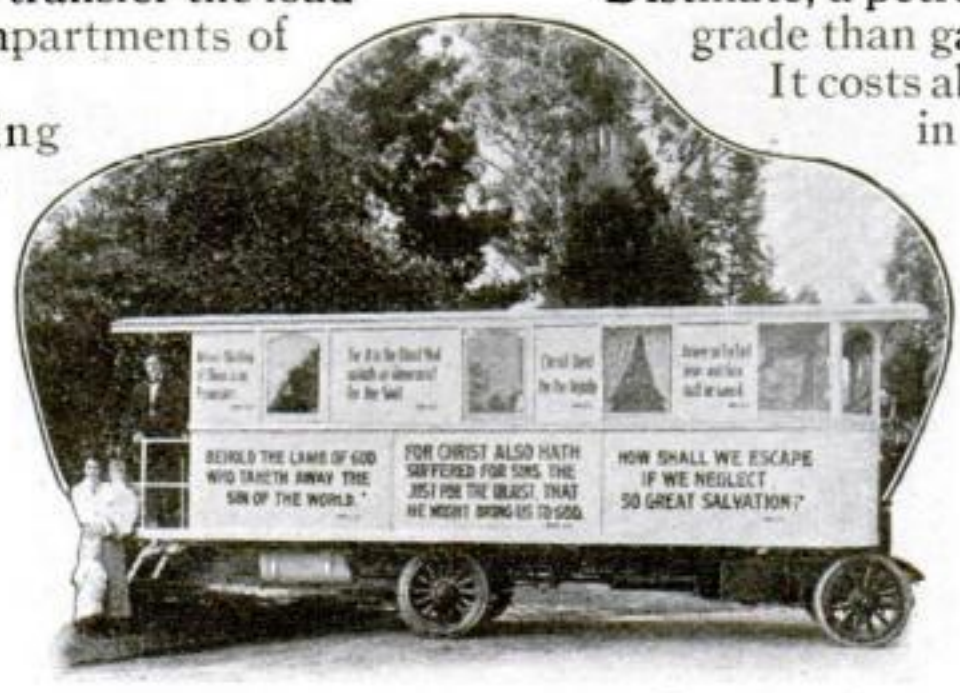
The accompanying photograph shows a tank truck at the dock in New London, Conn., delivering fuel to the United States submarine D-1 shortly before the submersible left port to participate in the naval pageant and maneuvers of the Atlantic Squadron.

Preaching the Gospel from an Automobile on the way from San Diego to Sweden

NELS THOMPSON, now an evangelist but formerly, as he says in his sermons, a follower of the race tracks, is bound from San Diego to Sweden, in the land-yacht church shown in the illustration. Thompson built the body, painted it and decorated it with religious texts. Then he purchased a two and one half ton chassis, mounted his church-home upon it, and started for San Diego. After holding revival services there he set out across the mountains to San Bernardino and thence eastward into the desert for a cross-country tour. On reaching the Atlantic coast he plans to ship his car to Sweden where he will resume his work.

Distillate, a petroleum product lower in grade than gasoline, is used for fuel. It costs about nine cents a gallon in the west. A distillate-burning range inside the truck draws its fuel from the same tank which feeds the engine.

Mr. Thompson does his own driving and makes his own repairs on the trip. His family travels with him in perfectly comfortable style.



The evangelist does his preaching from the platform of the truck. The interior is a cosy home

An Artistic Grocery Store in a Residential District

RESIDENTS of an exclusive suburban district in Portland, Oregon, objected strenuously when a grocer announced that he was going to build and conduct an establishment in their locality. Citizens even went so far as to invoke the law in their behalf, but they were overruled.

Now the building is finished and open for business, and those who were most opposed to it can but admit that so far as exterior appearances go, it gives no cause for complaint. An inconspicuous sign is all that indicates the nature of the building.

The grocery store as a fashionable dwelling-house. An inconspicuous sign is all that denotes its character

It is a one-story colonial style stucco structure, set back thirty feet from the sidewalk. Broad cement walks lead from the sidewalk to the front veranda of the store.

The windows are artistically curtained. Inside, groceries are displayed on shelves built like stairs, but there is a large fireplace to preserve the home-like effect.

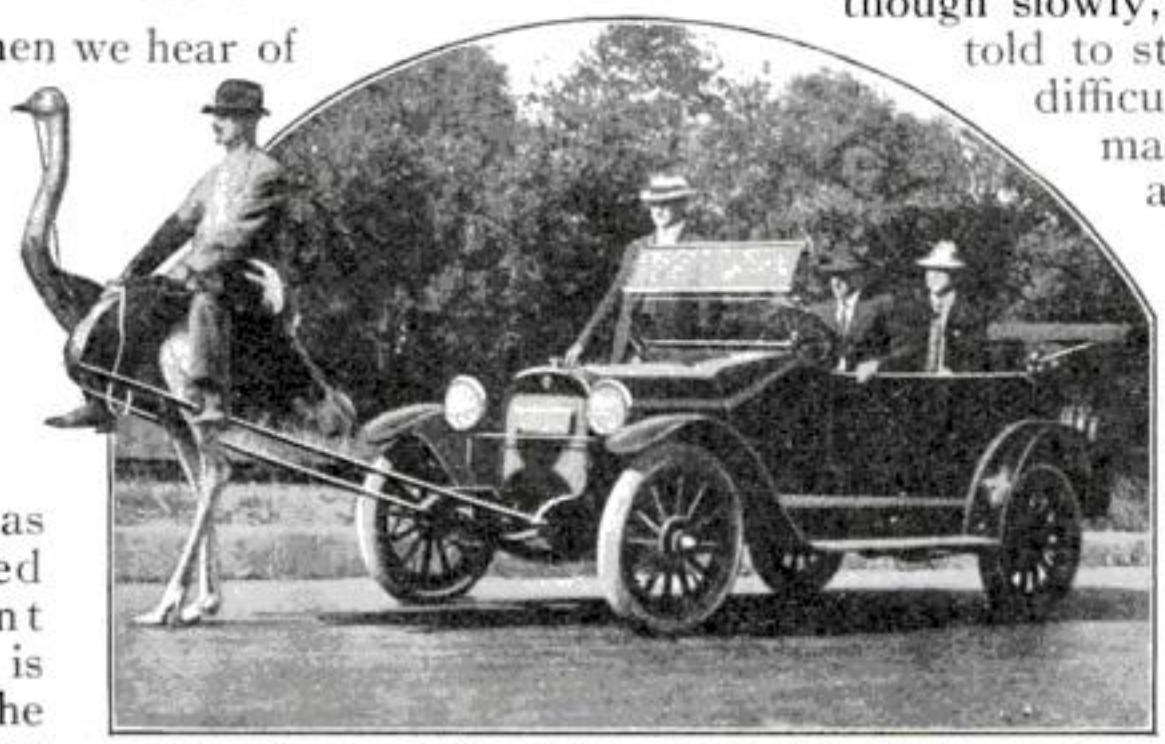
No goods are delivered through the front door. A concrete walk also leads from the rear door to the sidewalk, so that the impression of a residence is maintained.

Testing the Pulling Power of an Ostrich

NOW and then we hear of unusual "stunts" being performed in connection with an automobile, but it is probable that nothing more novel has been reported during recent months than is illustrated in the accompanying photograph—the pulling of an automobile by an ostrich. This test or performance came as a result of a discussion between the proprietor of one of the largest ostrich farms near Los Angeles, California, and a number of automobile men of that city. The farm proprietor claimed that the bird could pull the car. The automobile men doubted but they were ready and waiting to be convinced.

Several days later an Inter-State touring car was secured and run out to a boulevard close to the ostrich farm. One of the largest birds, with a sack over its head, was led through the farm-gate and immediately hitched to the front axle of the automobile by means of an especially prepared set of harness.

The trainer took his position upon the back of the bird and urged it forward, but just as soon as the traces became tight the ostrich balked and danced around. After repeated efforts had been unsuccessful in getting the bird to pull, the trainer thought he would try a different method. Suddenly he reached up and took the sack from off the bird's head and again urged it forward. The ostrich, upon seeing what was really expected of it, tightened the traces and kept on pulling, with the result that the car began to move, and continued, though slowly, until the bird was told to stop. To add to the difficulties of the test, the machine was headed up a slight grade. After being unhitched the ostrich walked slowly back into the farm yard amid the cheers of the spectators. The test was a demonstration of the intelligence of the bird, also, which has not been rated particularly high.

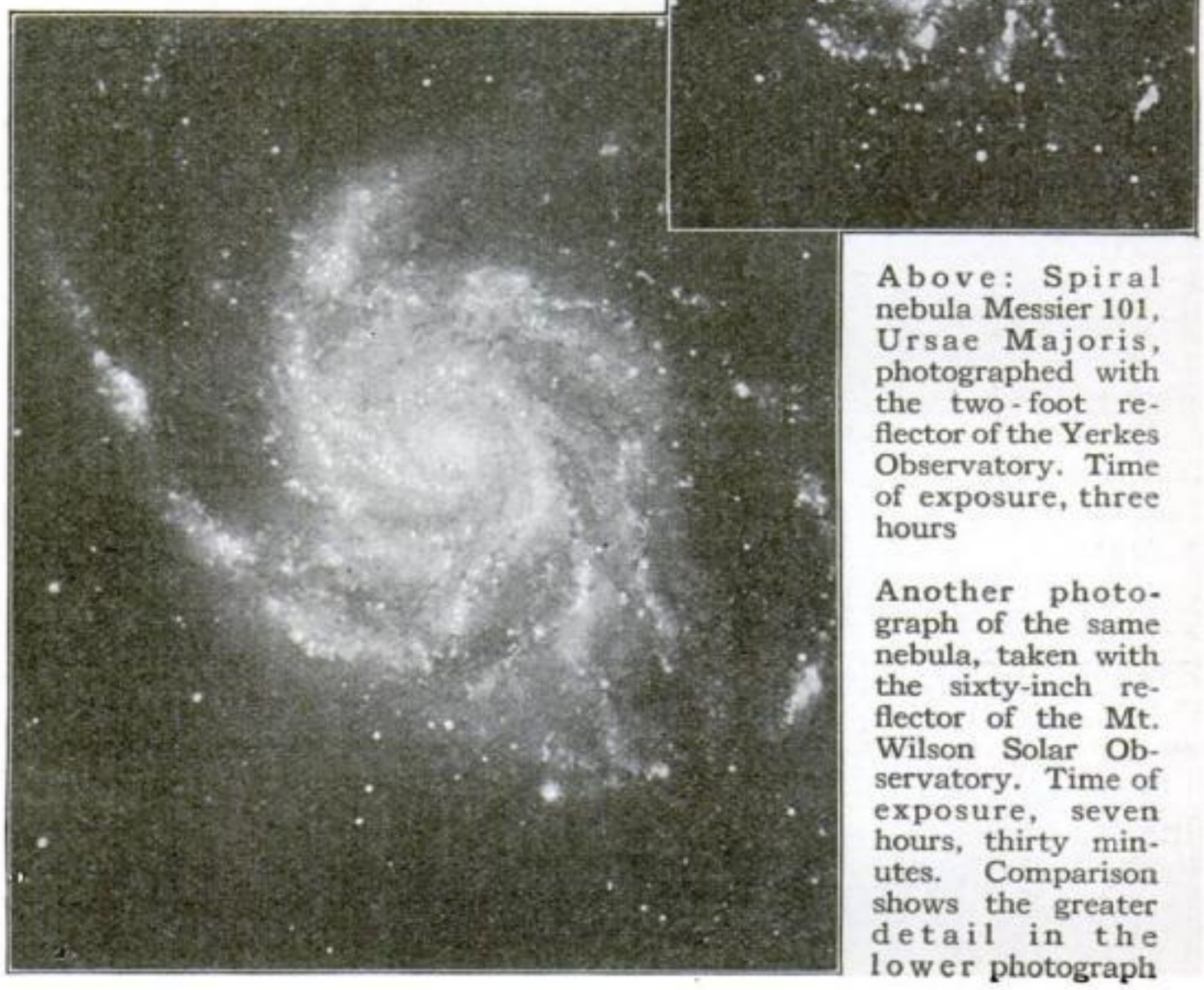


The ostrich sustained the weight of the driver and pulled the automobile uphill until told to stop

Studying the Stars with Mirrors

The biggest reflecting telescope in the world belongs to Canada

By Dr. C. Furness
Professor of Astronomy in Vassar College



Above: Spiral nebula Messier 101, Ursae Majoris, photographed with the two-foot reflector of the Yerkes Observatory. Time of exposure, three hours

Another photograph of the same nebula, taken with the sixty-inch reflector of the Mt. Wilson Solar Observatory. Time of exposure, seven hours, thirty minutes. Comparison shows the greater detail in the lower photograph

IT IS with the reflecting telescope that many of the most brilliant discoveries about stars are made. Its construction, however, is not so generally understood as that of the refracting telescope, the form of instrument which is so often seen in the parks or on the streets of our cities and through which the passerby can get a peep at the Moon for the trifling sum of five or ten cents. By calling attention first to certain facts regarding this more familiar type of telescope, it will be easier to make clear the construction of the reflecting telescope.

The lens at the upper end of a refracting telescope is called the object glass. It collects the rays of light and brings them together at a focus to form an image, which is viewed with a magnifying eyepiece. The largest refracting telescope is the well-known Yerkes instrument. It has an object glass forty inches in diameter.

In a reflecting telescope, the light is collected by reflection from the surface of a concave mirror. If this surface is ground to a parabolic shape, the rays will all come together at a single point to form an image, just as with the refracting telescope; but this point will be situated on the same side of the mirror as the object, and hence the observer who tries to look at a star will find his head in his own line of vision. In order to overcome this difficulty, a second reflection is made to take place, so as to deflect the beam of light and form the image at one side of the tube, where it may easily be examined with an eyepiece. This second reflection is accomplished by means of a plane mirror or "flat" inserted in the upper end of the tube and set at an angle of 45°. This flat will necessarily cut off some of the light falling upon the principal mirror, but since it is not large and since its supports are made as slender as possible, there is no serious loss.

A Mirror Six Feet in Diameter

At first mirrors were made of speculum metal, an alloy of copper and tin, which can be very highly polished. As early as 1842, the famous reflector of Lord Rosse was constructed. It had a mirror six feet in diameter. With this instrument many drawings of nebulae and planets were made. However, it never attained the usefulness which might have been expected, chiefly on

account of its unwieldiness. Mechanical appliances for supporting and moving heavy apparatus had not reached the perfection of the present day, and the six-foot telescope of Lord Rosse could not be moved more than ten degrees either side of the meridian.

On account of these difficulties, interest in the reflector lapsed, except in England, where it has always been a favorite. With the development of photography and its application to astronomy, its usefulness became very apparent. Within the last few decades, therefore, several large reflectors have been built. They are no longer made of speculum metal, but of glass, on the front surface of which a thin film of silver is chemically deposited.

Different Types of Reflectors

In this country there are several large reflectors, some of which are famous for the work which has been done with them. Thus, there is the Crossley three-foot reflector at the Lick Observatory, which was used by Prof. Keeler in photographing nebulae. The results of his labors showed that a very large number of nebulae have the spiral form shown in the accompanying illustrations. The Crossley instrument, however, was not of American origin. It was made in England and presented to Lick by its owner. Its installation was followed by the constructing and mounting of the two-foot reflector of the Yerkes Observatory, under the direction of G. W. Ritchey, who also made the mirror for the great sixty-inch instrument on Mt. Wilson and designed its mounting. A comparison of the two photographs of the same nebula (Messier 101 in Ursa Major), on the preceding page, taken with the two instruments, shows that both of them give beautiful results, but that the larger instrument has a greater wealth of detail.

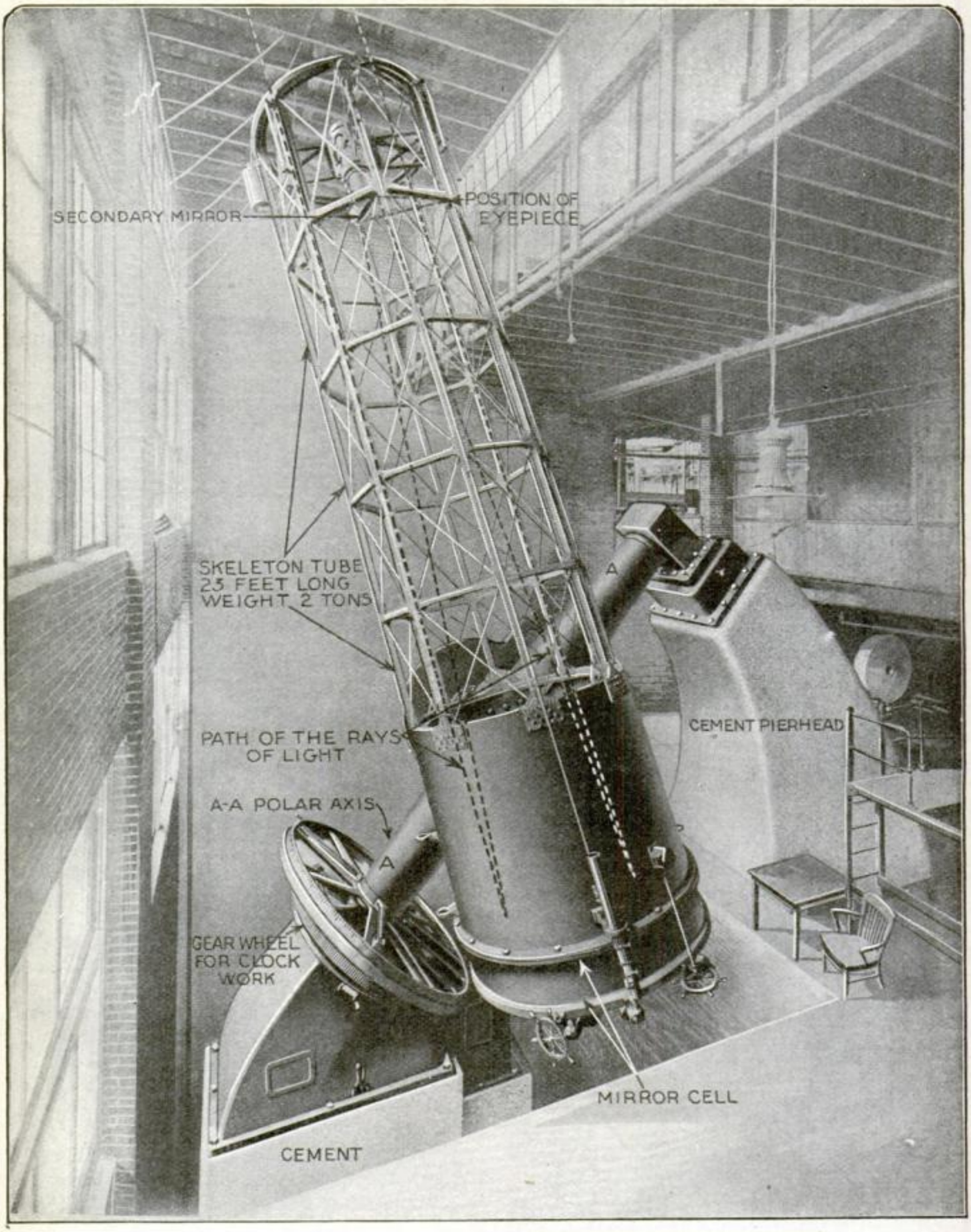
There is a forty-inch reflector at the Lowell Observatory in Flagstaff, Arizona, and two others are in process of construction—a hundred-inch for the Mt. Wilson Solar Observatory and a seventy-two-inch for the Dominion Observatory of Canada which is to be installed at Victoria in British Columbia.

The principles of construction are the same, whatever the size of the instrument, but the great weight of a large reflector makes the engineering problem a difficult one. The building of the seventy-two-inch Canadian instrument may be taken as an illustration of some of the mechanical difficulties to be surmounted, and the accompanying pictures have been selected to show different stages in its progress. One shows the mounting as it was set up in the workshop in Cleveland. The ends of the polar axis AA′ are supported on steel castings which are bolted to the heads of concrete piers. The permanent pier erected at Victoria is shown also. The polar axis must be set parallel to the axis of rotation of the earth. In the latitude of Victoria it makes an angle of more than 48° with the horizon. To the uprights of the framework of the walls are attached horizontal ribs which are for the purpose of supporting the sheet metal walls. It will be noticed that they are in pairs, being fastened both to the inner and the outer edges of the upright beams. The sheathing is attached to both sets, forming thus a double wall, with an intermediate air space of at least six inches. This structure must be made extremely stout in order to bear the enormous weight of the dome. One of the pictures shows the building complete, up to the covering of the dome. This is furnished with a system of shutters which with the double wall permit the interior of the building to maintain an even and moderate temperature. Electric motors are used in moving the telescope and dome. These are controlled by push buttons, located on small keyboards conveniently placed for the observer to use. An important part of the gearing is the clockwork, which carries the telescope with the rotation of the heavens, so that a star can be kept in the field of view as long as is desired. This must be made so that the telescope moves with absolute steadiness.

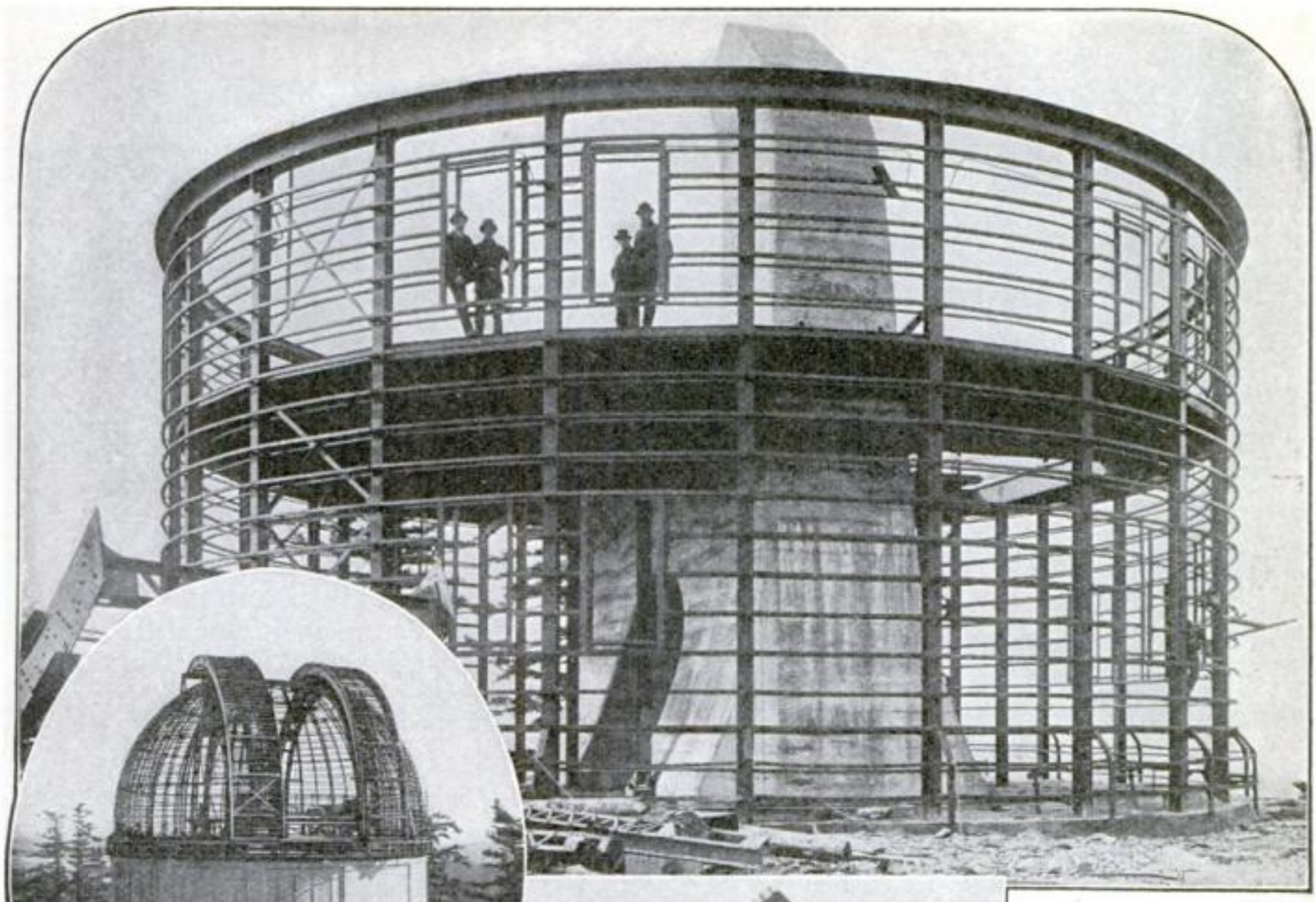
The optical parts of the instrument are being made by Brashear at Allegheny. The large mirror is twelve inches thick at the edges and will weigh over four thousand pounds.

What Good is a Reflecting Telescope?

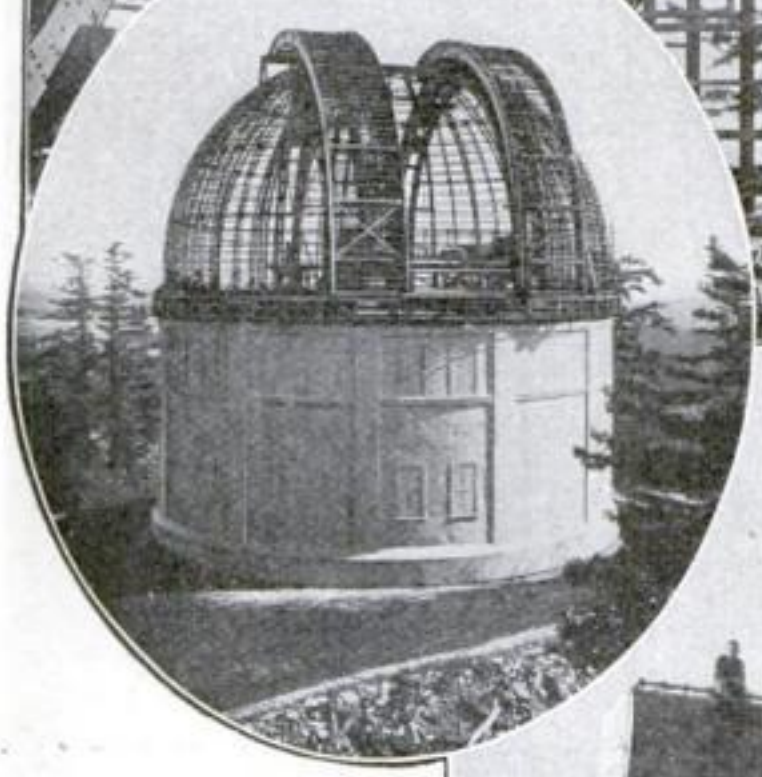
Having thus given somewhat in detail the construction of the reflecting telescope, it remains to describe the work which can most satisfactorily be done with it. First, it is used for direct photography, both for recording very faint objects and for getting fine details of brighter objects, such as nebulae. This is perhaps the use which appeals most directly to the general reader. We can also get the photographic images of very faint stars, the twentieth magnitude



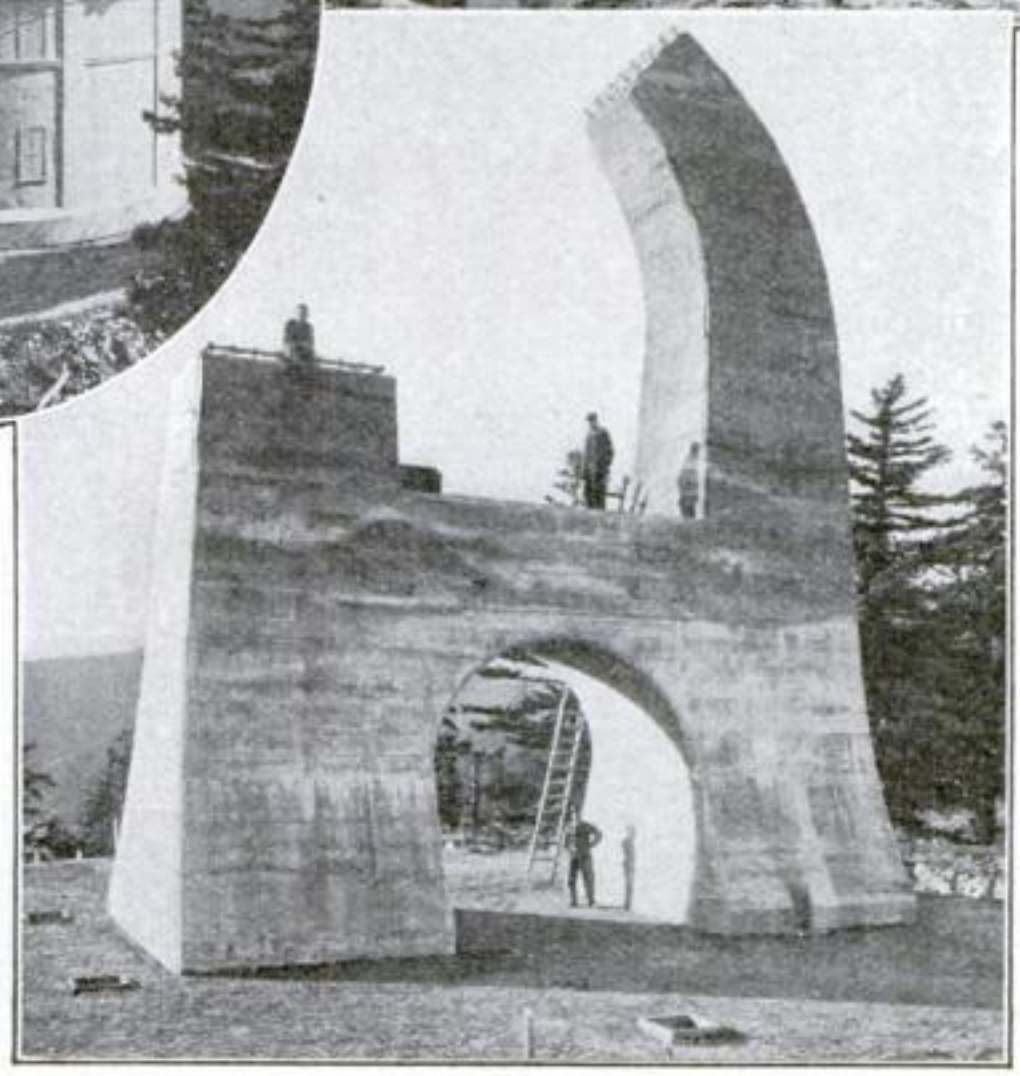
Mounting of the seventy-two-inch reflector of the Dominion Observatory of Canada, to be installed at Victoria, British Columbia. The principles of construction are the same whatever the size of the instrument, but the great weight of a large reflector makes the engineering problem a difficult one. The weight of the mirror cell with the mirror is six tons. The polar axis which is bolted to the pierheads, weighs ten tons. The skeleton tube weighs two tons. The dotted lines represent the path of the rays of light. The polar axis must be set parallel to the axis of rotation of the earth. In the latitude of Victoria, it makes an angle of more than forty-eight degrees with the horizon



Above: The iron framework of the walls. Horizontal ribs are attached in pairs both to the outer and inner edges of the upright beams, thus forming a double wall with an intermediate air-space



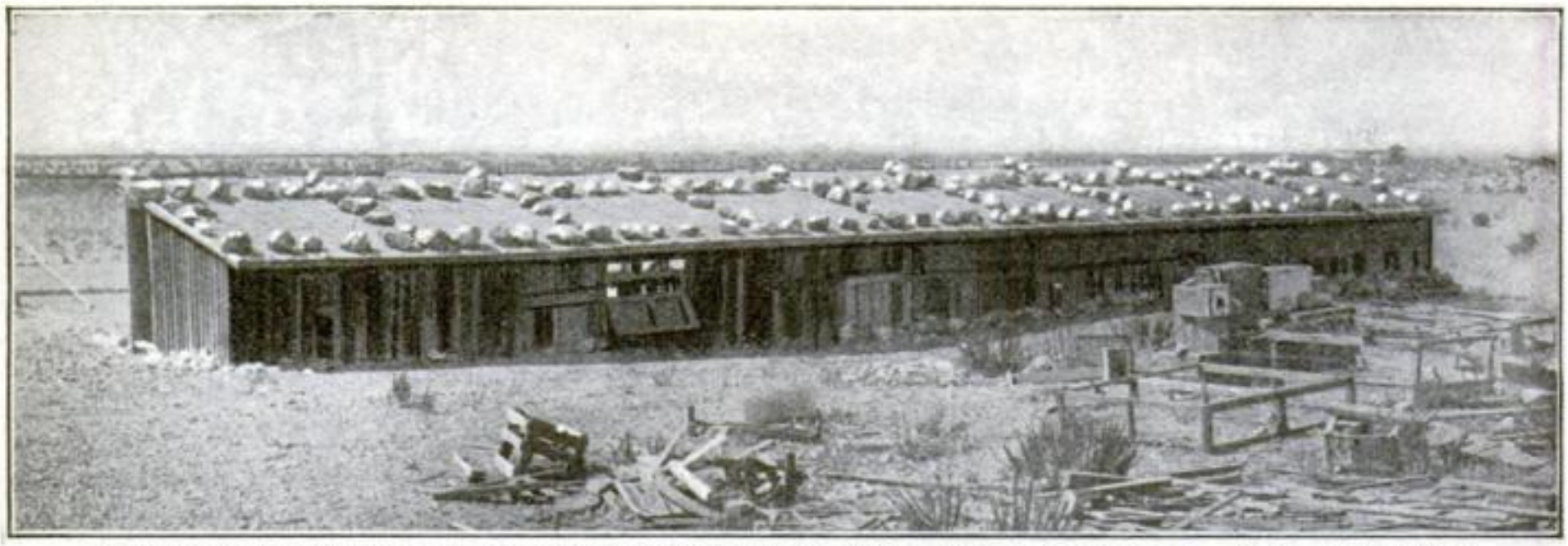
Above: The building complete, up to the covering of the dome. This is furnished with a system of shutters which with the double wall permit an even temperature to be maintained in the interior of the building



The permanent concrete pier at Victoria. The ends of the polar axis are supported on steel castings which are bolted to the heads of the piers

having already been captured. It is also extremely valuable for spectroscopic work. A long exposure is required even with the great forty-inch Yerkes refractor to obtain the spectrogram of a star of the fourth magnitude. This is much reduced at Mt. Wilson by using the short focus sixty-inch mirror, not only on account of the larger size, but also because the loss of light caused by reflection is much less than that suffered by a ray of light in passing through the thick lenses of a large refractor.

Recently, a great deal of attention has been paid to the study of the spectra of nebulae, and some extraordinary results have been obtained. It has been found that some of them show evidences of rotation, a most important fact in its bearing on the evolution of star systems, if it can be established by photography.



Several tons of stones were used to insure the safety of these henhouses. Care was taken to place the stones directly above the roof supports of the partitions to prevent sagging

Anchoring the Henhouse in Cyclone Districts

A RANCHER in Southern California had been troubled by the severe windstorms of that section, which threatened to wreck his henhouses. Finally he thought of weighting down the roofs with large boulders weighing from thirty to fifty pounds. He was careful to place them directly above the roof supports, that is above the four walls and the partitions.

A British Motor-Bus Run on Ordinary Coal Gas

THE scarcity of gasoline in England and its consequent high price has caused the owner of the motor-bus, shown in the accompanying illustration, to use ordinary coal gas to drive it. This is new in application yet old in principle. Many American automobile manufacturers have used coal gas to test their motors, because it is considerably cheaper than gasoline now.

The special feature of the method illustrated here is that the gas is carried under low pressure in a large bag strapped to the roof of the 'bus, instead of in steel cylinders at high pressure. This eliminates the cost of compressing the gas and enables it to be fed into the bag direct from the town supply tank line anywhere along the route.

A flexible pipe is used to convey the gas from the bag to the engine intake manifold just above the throttle, the function of the carbureter being eliminated, except to provide a sufficient amount of air to mix with the gas fuel. An ordinary cock, placed in the gas line close to the motor and directly coupled to the throttle-valve lever, controls the supply in accordance with the engine speed.

The gas bag, a simple canvas sack with a rubber insertion, does not offer much head resistance, because it gives with the wind and presents a streamline form. It holds four hundred and fifty cubic feet of gas, which is sufficient to drive the 'bus for twelve miles without refilling. It is said that by test the cost of gas fuel for the 'bus is but one cent a mile, while with gasoline it is six cents per mile.

Many other tests of ordinary town gas for running automobiles have been made both here and in England. A Glasgow resident ran his automobile on ordinary town gas by removing the jet nozzle of the gasoline carbureter and substituting a grilled plate. This was done to break up the flow of gas and to enable the air to mix with it properly. A lever on the steering wheel controlled the amount of gas.

The gas is carried under low pressure in a large bag strapped to the roof of the 'bus

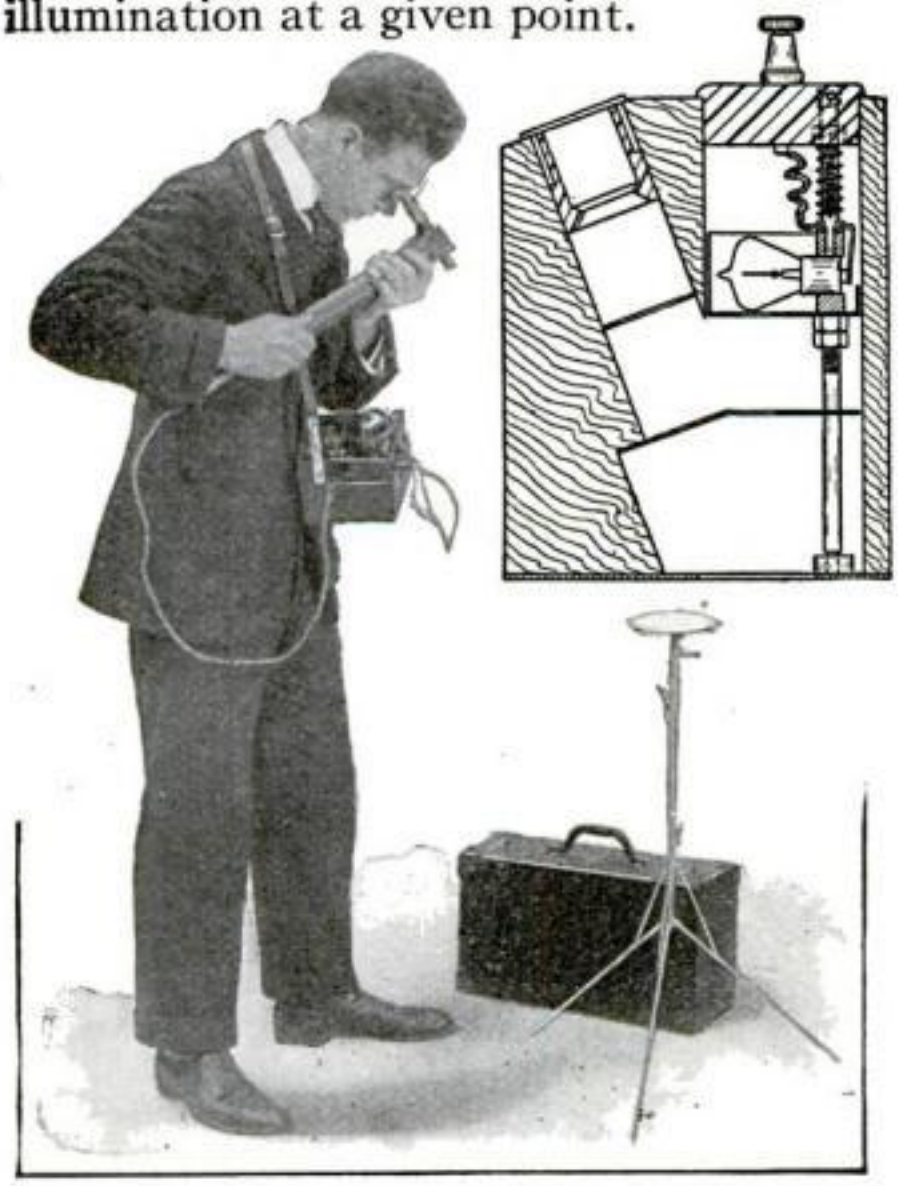
Determining the Intensity of Illumination by a New Measuring System

A NEW and convenient type of instrument for the measurement of light has been developed by Norman Macbeth, illuminating engineer. It differs from the photometer, an instrument somewhat similar, only in the details of its construction and in that its scale is calibrated to read in foot-candles. But the method of its use is different.

To measure illumination intensities a test-plate, made of white material of good diffusing qualities, is placed at the point in the plane where the illumination value is desired. It becomes a secondary source of light, the brightness of which is compared with that of a translucent screen, the measuring instrument of which is illuminated to a known intensity by a small tungsten lamp.

The intensity of any source of illumination may be determined by placing the test-plate a known distance from the source, measuring the illumination-intensity in foot-candles upon the test-plate and then computing the candlepower by multiplying the scale values by the square of the distance of the test-plate from the unknown source (the law of inverse squares).

The scale is calibrated in foot-candles and the readings give the intensity of illumination at a given point.

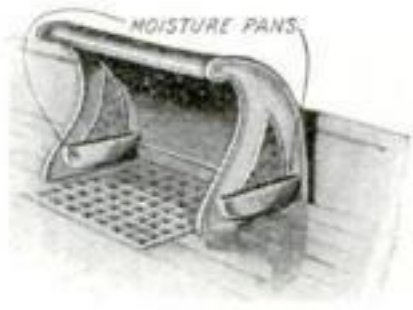


The lamp carriage is moved up and down in the tube by means of a rack and pinion operating upon a brass rod

The aperture opposite the telescope is pointed toward the test-plate or any surface whose brightness is to be measured

Deflecting and Moistening the Air from Furnace Registers

UNTIL we substituted the modern hot-air furnace for the stove we did not know what a completely warmed house was during the winter months. But evil accompanies good. The heated air from the furnace is too dry for good health and perfect comfort, and as an additional worriment, the walls at the sides and above the registers soon become discolored by the blackened dust which rises and disperses through the rooms of the house whenever the ashes are shaken down or the furnace cleaned.



The registers are provided with water-pans to moisten the air

To obviate these troubles a register-shield has been placed on the market, which may be inserted over either floor or wall registers. These metal shields deflect the rising stream of hot air and direct it out into the room instead of allowing it to go directly toward the ceiling, as it otherwise would. The shields are also provided with water-pans which are kept warm by the air from the furnace. The water evaporates and moistens the air as it passes through the shield.

Removing Old Starch from Clothes by a Malt Extract Bath

AS starch is insoluble in water it has always been a hard problem of the laundryman to remove it from soiled collars, lace curtains or other articles which are either heavily starched or made from delicate material.

Strong, hot alkaline baths and long rubbing or pounding have been the principal resort, although they shorten the life of the fabrics, destroying wool fibers, shrinking cotton and spoiling colors.

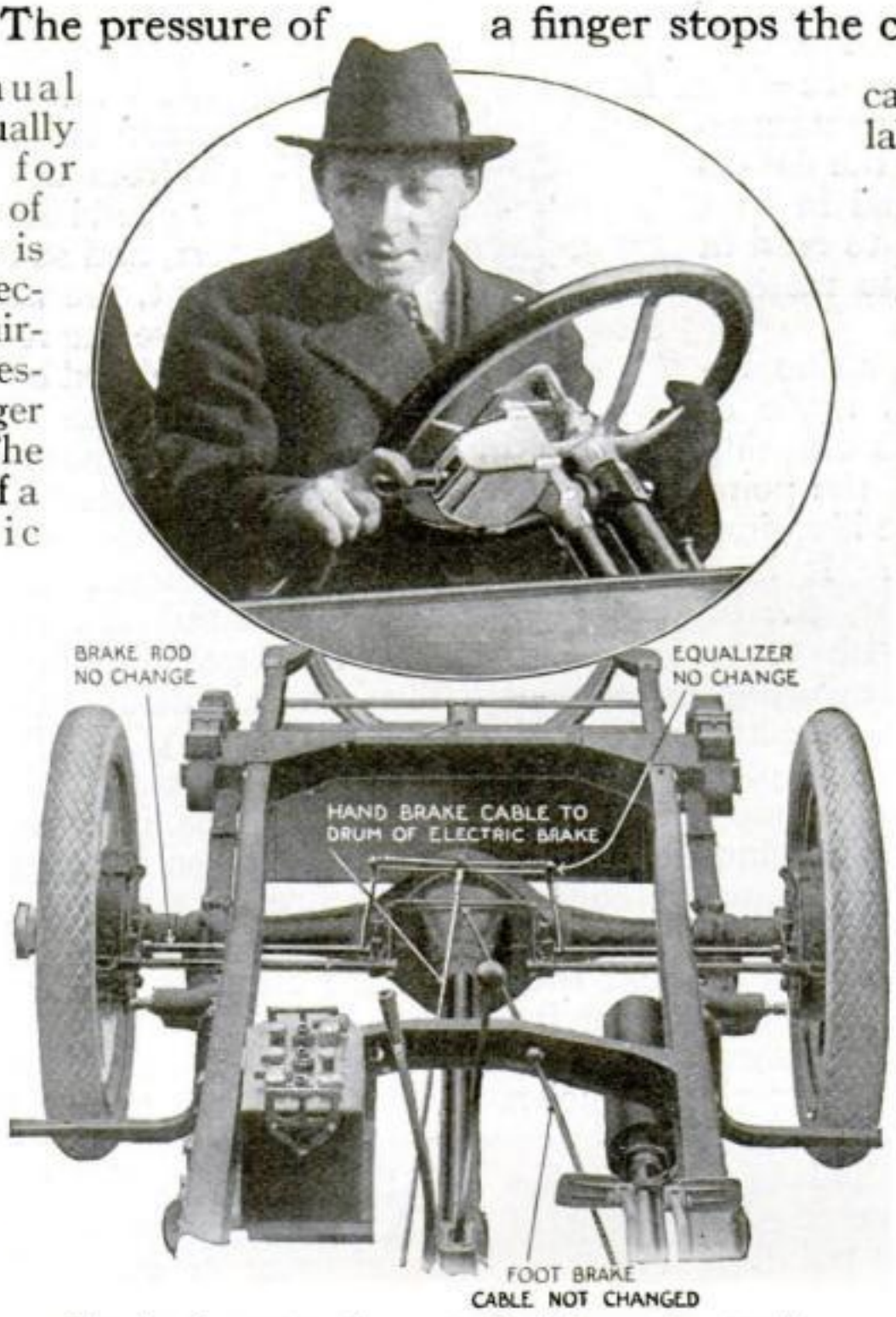
Modern laundries are beginning to introduce the malt extract bath as a substitute for the alkalies in laundries. Malt is a chemical compound having the property of converting starches or starchy foods into soluble dextrine or glucose. It requires only four ounces of malt extract to remove the old starch from one hundred collars or an equivalent amount of goods, and it is not affected by hard water.

A Motor-Driven Brake

The pressure of a finger stops the car

THE manual labor usually required for the handbrakes of a motor vehicle is avoided by an electric brake requiring only the pressure of one finger to operate it. The device consists of a small electric motor which drives a tiny drum carrying a steel cable attached to the brake-equalizer and to the regular brake-drums. The motor is controlled from the steering-wheel column.

The motor with its drum can be located under the body, under the driver's seat or under the motor-hood, as shown in the accompanying illustration. It takes up very little space, since it is only four inches high, six inches wide and eight inches long. It can be attached to any car simply by substituting it for the usual hand-levers, lever quadrant and brake-rod connections.



The brake-motor is controlled from the steering-wheel column by simply moving a switch-handle

The controller consists of a two-point switch enclosed in a small housing bolted to the steering-wheel column directly beneath the wheel, within easy reach of the driver's hand. A simple movement of the switch-handle controls the brake throughout its entire range of operation, thus making it very easy for a woman to drive even the heaviest of cars. The manual labor in braking is analogous to that of cranking the motor, which was done away with by the electric starter, so that the ultimate general application of some form of mechanical brake is practically assured.

The electric brake draws its operating power from the regular vehicle battery which may be of 6, 12 or 24 volts. The current consumed is said to be very slight.

The device contains several novel mechanical features, the total reduction from the brake-motor to the drum carrying the brake-cable being four hundred to one. This is secured by means of a non-reversible worm-gear on the armature-shaft which drives another gear in mesh with an internal-toothed gear on the cable-drum. Between the drum and the worm-gear is an adjustable friction-clutch by means of which sufficient pressure is secured to transmit the maximum braking effect, but beyond which, it will slip. After a thousand-pound pull has been exerted on the cable, the slipping clutch comes into play, preventing any further pull, while a ratchet keeps the brake from slipping off.

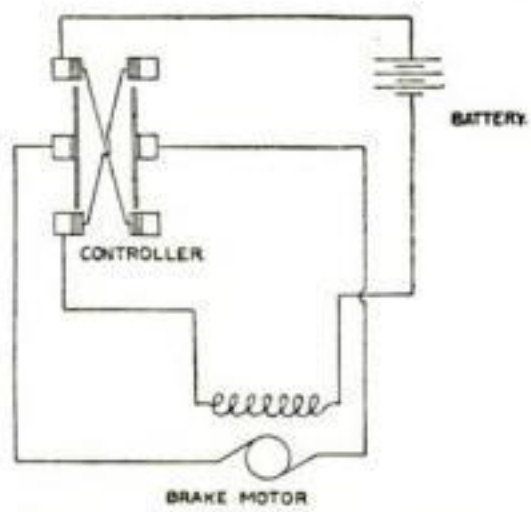
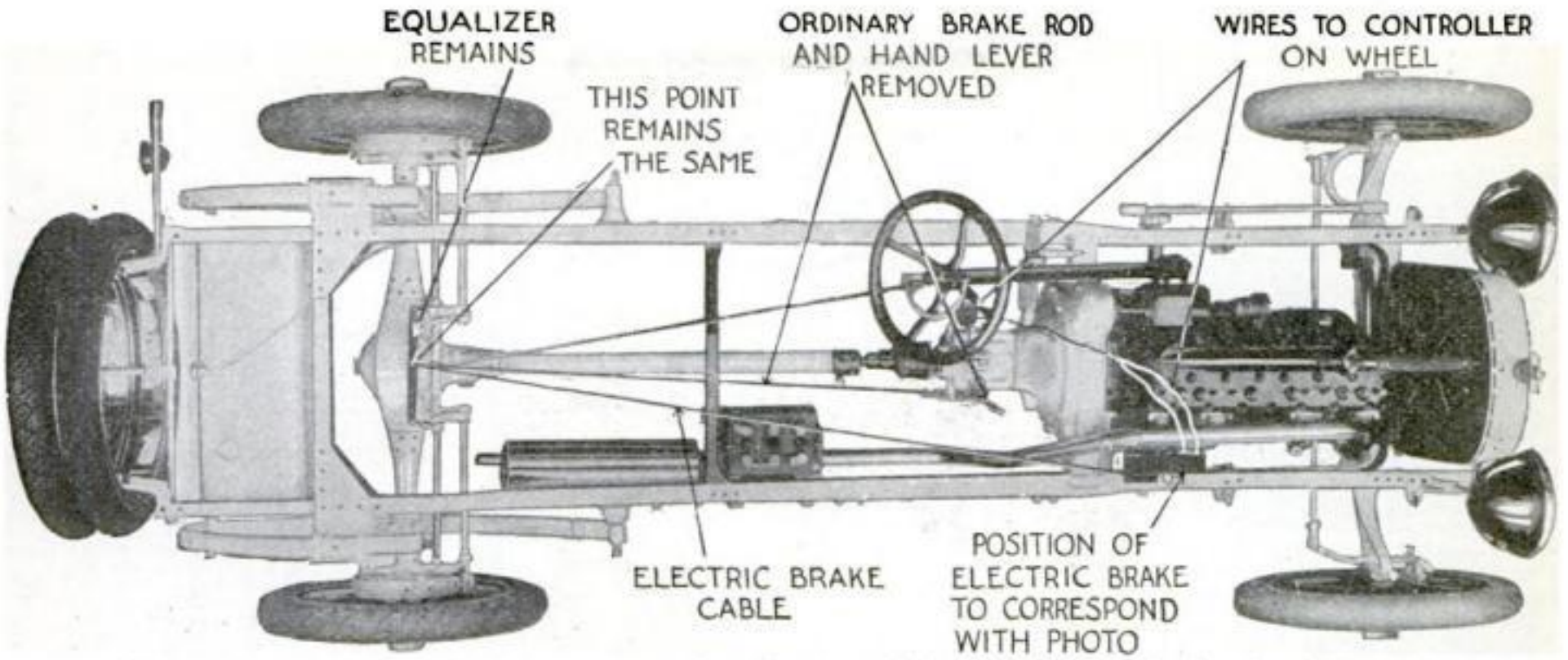


Diagram showing controller and the power connection

Because of the powerful



The motor can be attached to any make of automobile simply by substituting it for the usual hand-levers, lever quadrant and brake connections. The brake is disengaged by pushing the switch-handle back to its original position. The device weighs twenty-five pounds

pull on the brake-cable, it has been found feasible to have the brake-drums run in oil, reversing the usual practice which is to keep them as dry as possible.

By means of the two-point switch-controller, the electrical energy is so governed that the brake can be applied gradually or in the fraction of a second in an emergency. The first-point switch position supplies enough braking power for service purposes and the second for an emergency stop.

A Device for Adjusting the Ends of Steel Rails

A RAILROAD man of Louisiana has invented a device for adjusting rails, which is employed at the rail-ends where space is allowed for expansion and contraction.

Two strong clamps are provided, one of which is fitted over each end of the adjoining rails. A double-threaded screw connects them. Over this a rod is fitted, by means of which the screw is turned to spread the rails or draw them together as desired.

One of the clamps fits over each rail-end and a screw-rod spreads or joins them

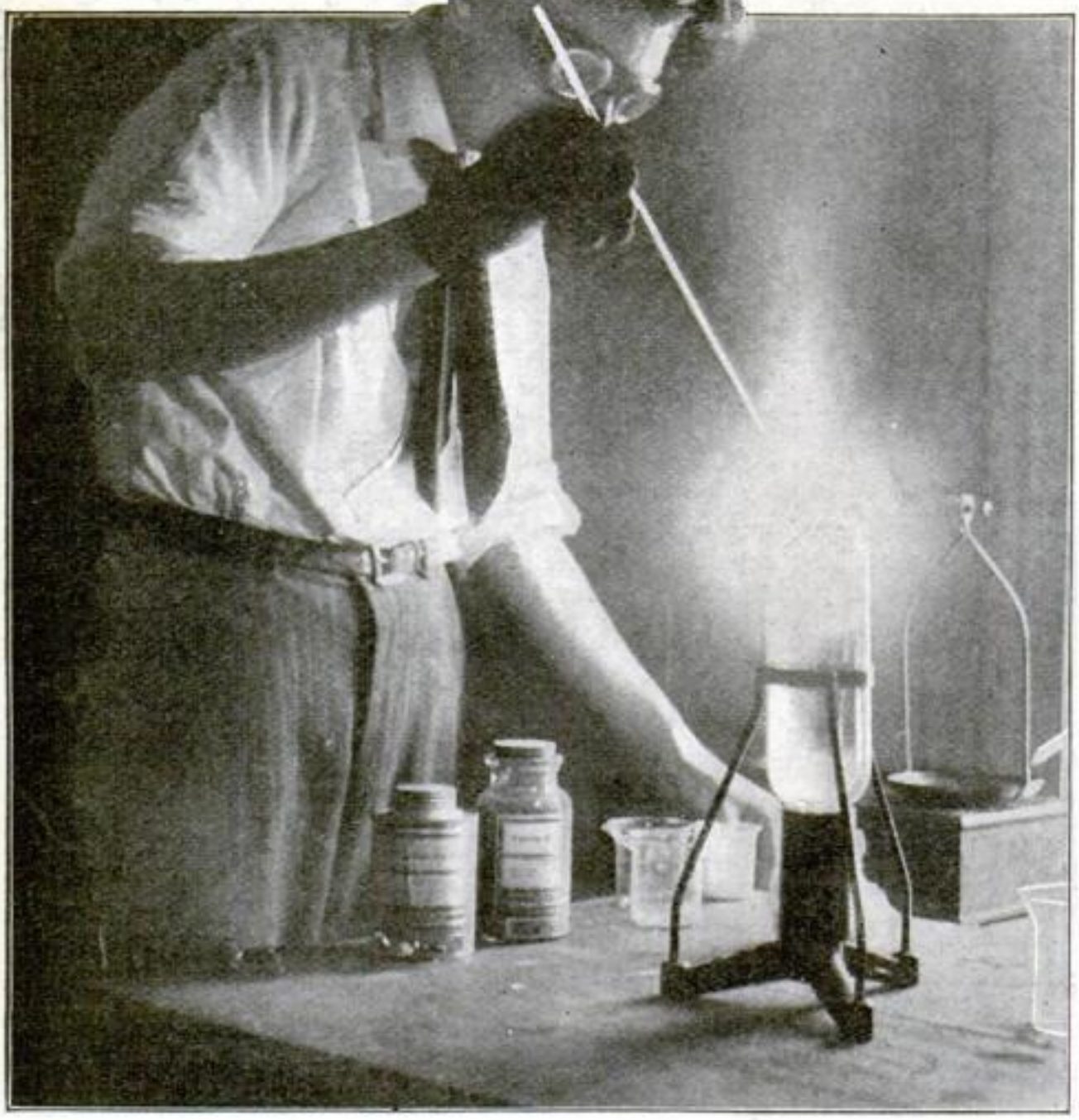
Wire Wheels for Automobiles Are Rapidly Taking the Place of Wood

ONE of the most interesting tendencies of the times in the automobile-manufacturing business is the growing popularity of the wire wheel. An examination of the statistics of wheel production in this country reveals the fact that a distinct wire wheel boom is under way and is rapidly gaining momentum. At the end of 1915 it was estimated that there were not more than ten thousand cars equipped with wire wheels. The 1916 season, though not yet finished, has probably added fifty or even sixty thousand cars to this class, a gain of five hundred per cent. With that spectacular increase in mind it is not difficult to credit well-informed automobile men who predict that 1917 will see two hundred thousand new cars put on wire wheels. These wheels are popular on account of their handsome appearance; and they have received an impetus from the scarcity of hickory of the best quality, and from the patent litigation which has vexed the manufacturers of the demountable rim.

Producing the Coldest Cold

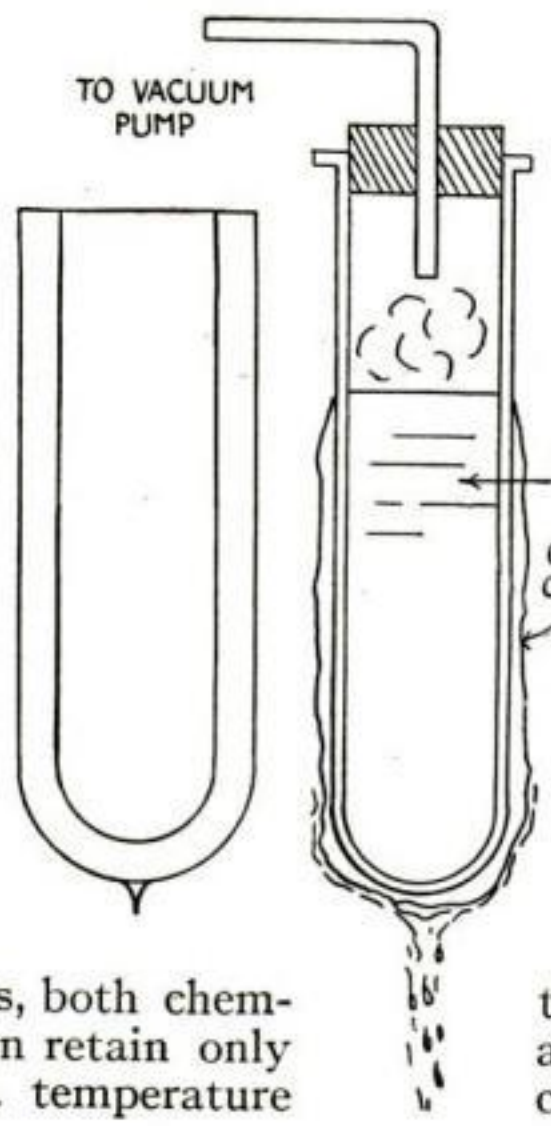
Think of 400 degrees below zero!

Think of gases that have been squeezed and cooled until they look like water!



Burning a piece of cold-rolled steel in liquid air. The liquefied oxygen combines so rapidly with the metal that a furious heat is produced

At right: By using a vacuum pump the rate of evaporation can be increased enough to freeze the air contacting the outside of the tube



AMONG the more startling discoveries of the past decade is the production of temperatures reaching as far as 400° F. below zero. It is the attainment of these low temperatures that has brought the chemist and physicist into a new world; for when matter is subjected to such degrees of cold, there is a complete alteration of both its chemical and physical properties.

Each substance on our earth has individual properties, both chemical and physical, which it can retain only at a specific temperature—a temperature which nature set for it. If we alter this temperature by artificial means the substance will gradually assume a different physical state. This change of state is "forced" upon it, and when we withdraw the artificial means of changing its temperature, nature promptly transforms the substance into its original state. As an example, water at ordinary temperature is a liquid. If we heat it to 212° F. it becomes steam, and if we cool it to 32° F. it becomes a solid.

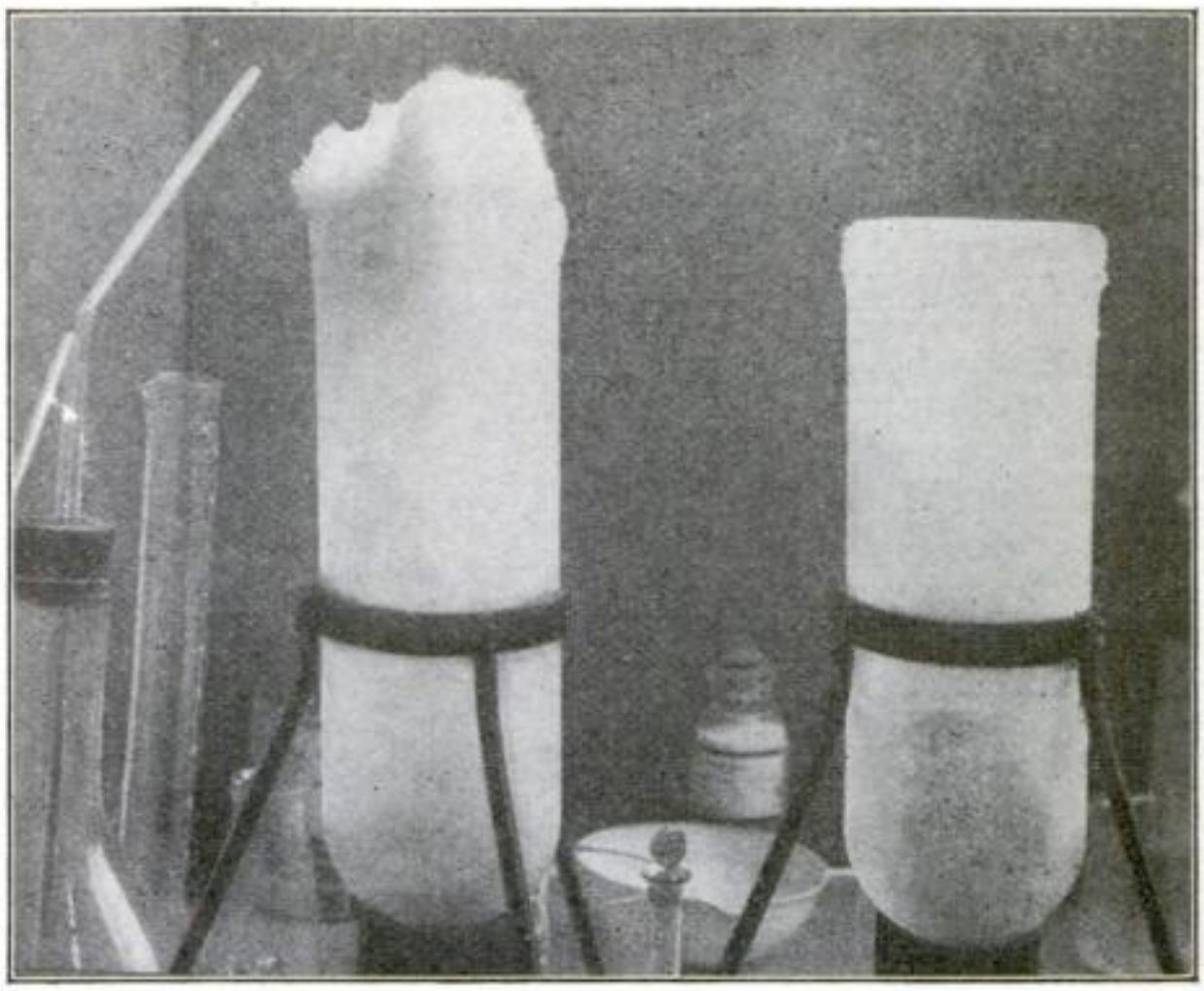
What is known as the kinetic theory of matter tells us that all molecules are in perpetual vibration at a tremendous velocity and are continually colliding with one another. This rate of molecular vibration produces the temperature of matter—the higher the rate of motion the greater the temperature and vice versa. The molecules are incessantly giving out their energy of motion and at the same time are receiving these mechanical impulses from other particles of matter. With these simple facts in mind, we may continue more intelligently.

When we boil water we merely impart energy in the form of heat to the molecules. If the source of heat is intense enough, the particles become so wild in their vibration that they come out of the range of their natural mutual attraction and pass off as vapor. If this vapor is cooled it again assumes the liquid state, because we have taken energy

from the molecules and have caused them to return to their natural degree of vibration. If we continue to cool the liquid, we still further paralyze the motion of the molecules, until they become so crowded together that we have a solid—ice.

To Change a Gas into a Liquid—Cool It

Now, then, in the light of the knowledge imparted in the foregoing paragraphs, if we wish to change a gas to a liquid we must cool it. This is true. If sulphur dioxide (a gas obtained by burning sulphur) is cooled to a few degrees below zero, it condenses into a liquid. As soon as the artificial means of cooling the gas is withdrawn, it rapidly assumes its natural state, as gas, by evaporation.* Now to get back to its natural state it needs a specific amount of heat to make its molecules vibrate at a definite rate, that which nature determined. Where does it get this heat? It abstracts it from its surroundings so rapidly that a still further degree of coldness is realized as the gas is formed from the liquid and passes off carrying with it its natural amount of heat which it has greedily robbed from material in contact with it. For commercial purposes liquid carbon dioxide is stored under great pressure in durable steel cylinders. If the jet on the cylinder is opened, the liquid evaporates so rapidly that the temperature of the container is soon lowered far below zero, and a solid formation of carbon dioxide appears on the mouth of the jet.



Part of condenser in a laboratory refrigerating apparatus. The chamber is so cold that frost is formed. Yet liquid air would boil briskly if placed on the tubes

The tin cup on the right was frozen by immersion in liquid air, after which it was easily broken

At left: What remains of a large rubber cork after it has been frozen and struck with a hammer

At left below: Two screweyes frozen into a block of mercury so solidly that they sustain the weight of two flatirons suspended from a great height

Professor Dewar liquefied hydrogen and helium in the laboratory of the Royal Society by a different method from that of rapid evaporation. The principle applied by him is based on the fact that a compressed gas allowed to expand freely greatly lowers its own temperature. Lord Kelvin made known this fact early in his career, and it was commercially utilized by Linde, a German scientist, and by Hampson, an English physician. Both workers were laboring independently of each other.

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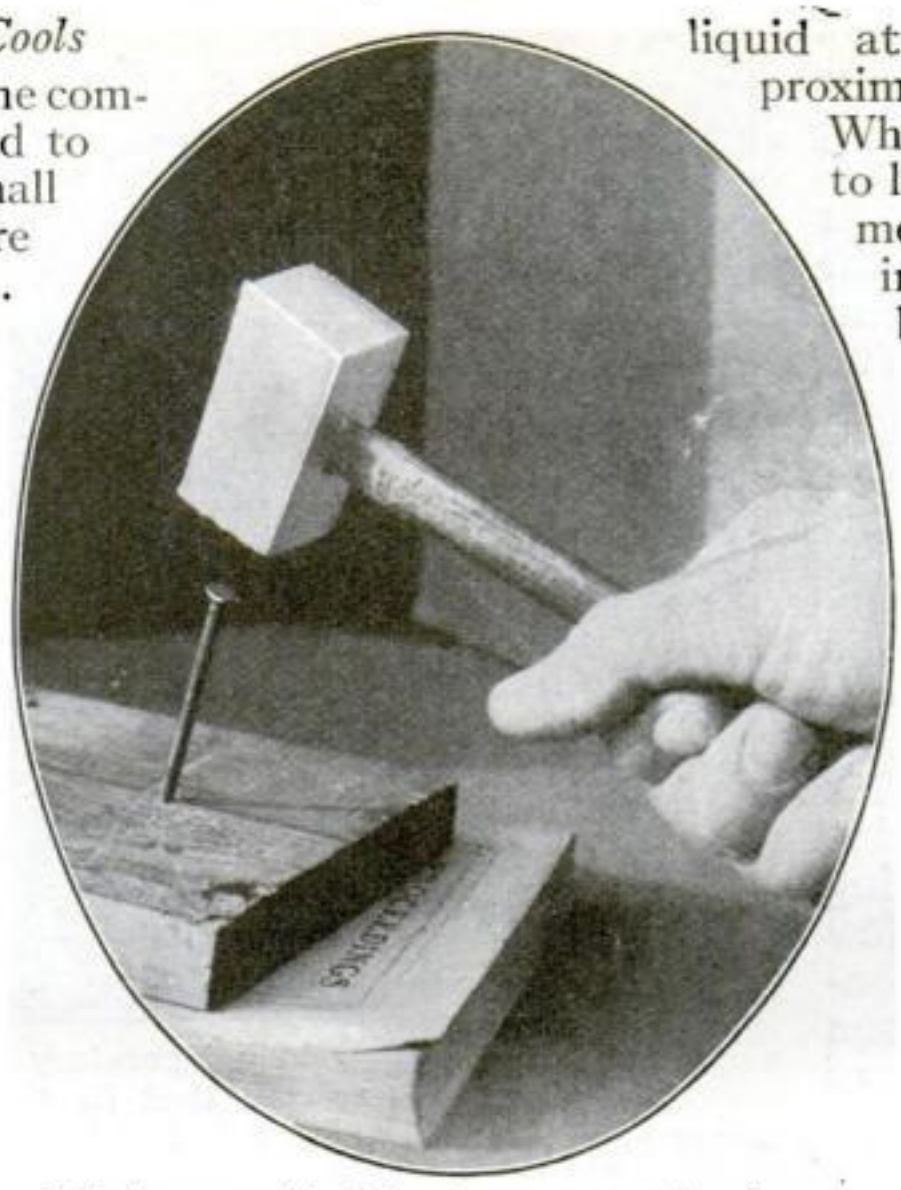
*This is assuming that the gas is not stored under pressure, which prevents evaporation.

How Expansion Cools

It was found that if the compressed gas was allowed to expand through a small opening its temperature was still further lowered.

Working with these facts in mind, Linde and Hampson perfected a process by which they were able not only to obtain far lower temperatures than with the old evaporative method, but to liquefy gases that had hitherto resisted all efforts. The apparatus used consists of a coil of pipe (see diagram) through which the compressed gas is permitted to pass and expand through a small opening at the end. First, the air is brought to a pressure of 200 atmospheres by means of the compressor. It is discharged from this through the valve *N* and into the water-cooled jacket *C* where the heat of compression is abstracted. From there it flows through the smaller coiled pipe which is concentrically arranged within the larger one. As the air reaches the expansion valve *H*, and flows into the heat-insulated chamber *E*, its temperature is greatly lowered. The cooled air then rushes back through the larger pipe and lowers the temperature of the succeeding air coming through the smaller pipe. It will be seen, then, that the air emanating at *H* will gradually become colder until a liquid state is reached.

Dr. Hampson's apparatus for the liquefaction of gaseous matter was designed with such ingenuity and constructed so perfectly that compressed air at ordinary temperatures passed through the coil came out as a liquid at the nozzle in approximately six minutes.



Driving a nail with a hammer made of mercury frozen solid by immersion in liquid air

When attempts were made to liquefy hydrogen by this means, it was found that instead of being cocled by expansion its temperature was actually raised. Later it was discovered that hydrogen obeyed this law only when its substance was first cooled by contact with some refrigerating medium. In the apparatus employed to-day for the liquefaction of hydrogen, the gas is first reduced to a low temperature by means of solid carbonic acid and liquid air. By this means, Dewar also brought helium to a liquid state.

Gases That Look Like Water

The fact that these liquid gases cannot be kept in ordinary containers should be readily appreciated by the reader when it is understood how rapidly they abstract heat from their surroundings. If liquid air is poured into an ordinary glass vessel it immediately starts to boil and will reduce the container to bits. It must be remembered that liquid air has a boiling point about 180° Centigrade below zero. If liquid gases, then, are to be kept any length of time they must in some way be insulated from the heat of their surroundings. It has been known for a long time that nothing but tangible matter will conduct heat waves. Dewar ingeniously took advantage of this fact in a method by means of which he can preserve liquid gases over a considerable period of time. He uses a glass vessel with two walls between which a high vacuum prevails. If a small

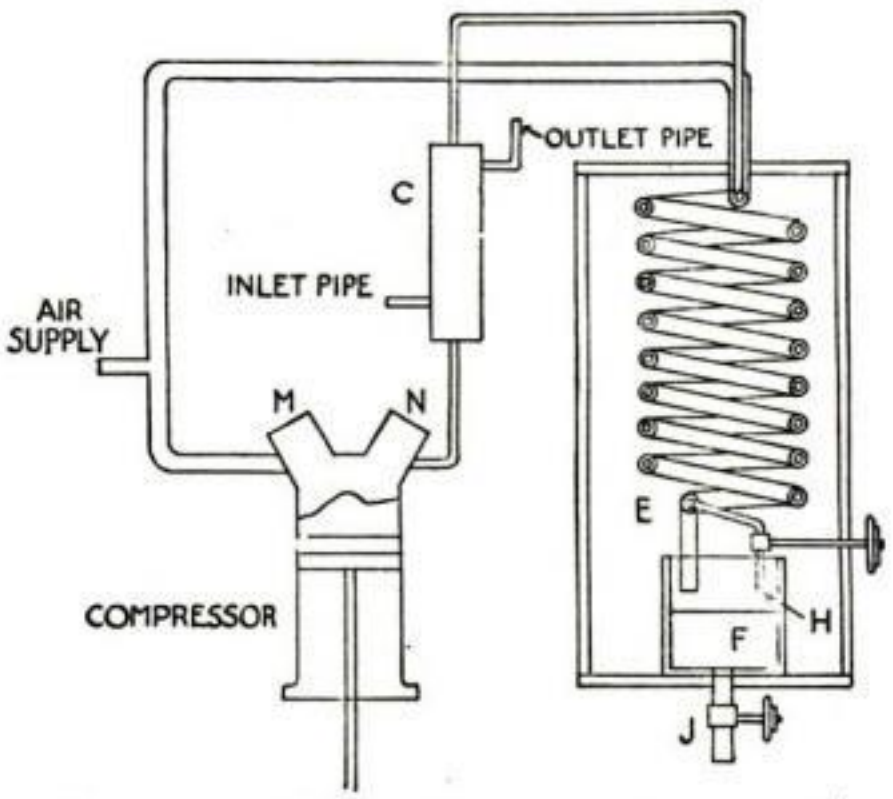


Diagram explaining the apparatus used in the Linde process for the liquefaction of gases

amount of mercury vapor is left between the walls, it will be solidified and deposited upon the walls of the vessel upon the entrance of a liquid gas. In this manner it acts as a mirror and reflects heat waves that impinge upon the outer surface of the container. Thus was the familiar commercial vacuum bottle created.

Now that the methods for producing low temperatures have been explained, we will briefly review some of the more wonderful phenomena that occur when matter is subjected to such severe low temperatures.

Strange Things That Happen When Gases Are Liquefied

If a piece of silver forming part of an electrical circuit is immersed in liquid air and held there, it undergoes a physical modification that reduces its electrical resistivity to an almost unnoticeable amount. It was predicted by physicists that at absolute zero a metallic substance would offer no resistance to an electrical current.

Professor Dewar discovered that if a magnet was repeatedly immersed in liquid air, its magnetic influence was not only intensified but permanently increased. Also, curiously enough, oxygen may be separated from the nitrogen in liquid air by magnetic means.

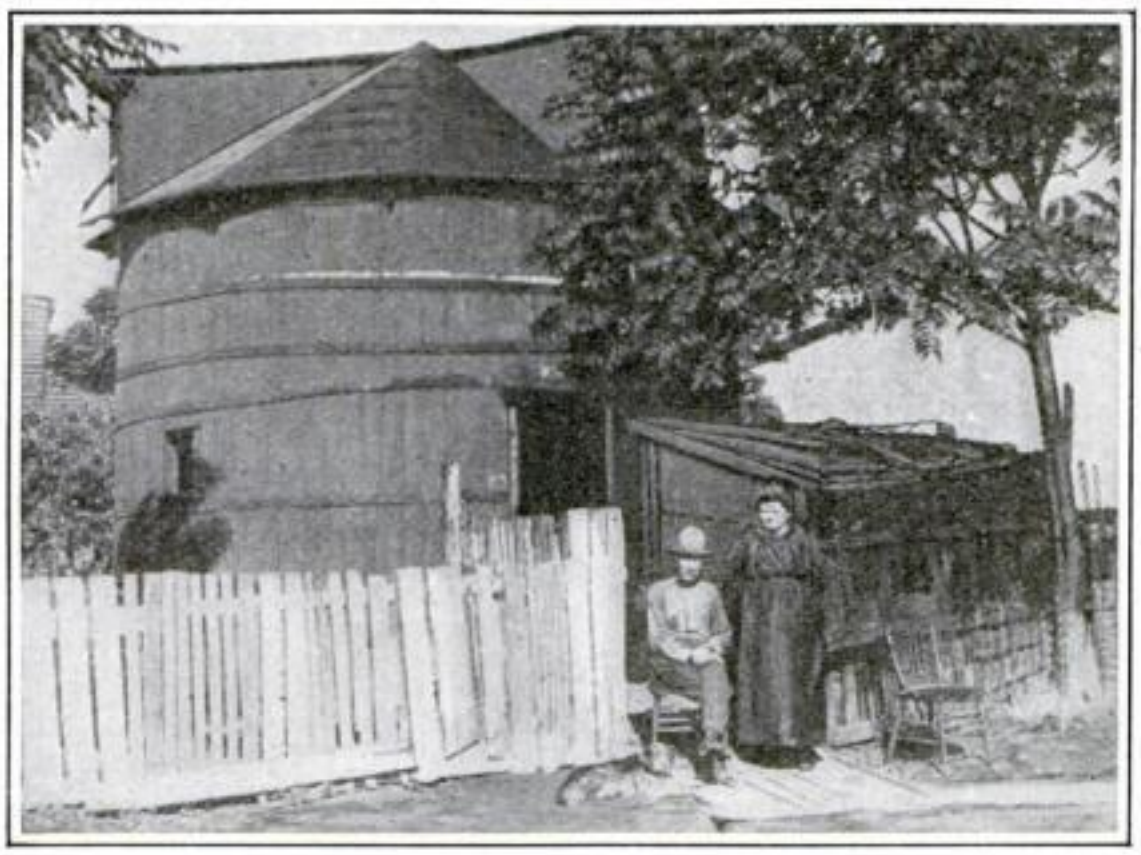
A student of physics would naturally ask: Will a liquid gas alter the color or light-absorption of a substance? The answer is, yes. Understanding, as we do, that the color of a substance depends upon the wavelength of the ether waves of the spectrum it absorbs, it would be natural and tempting for one to conclude that it was the great contraction of the molecules that affected its wave absorption at this temperature. We must be more cautious than positive in making this pretty assertion as final at this time. It has been found, however, that at these low temperatures red things become yellow and yellow things white and so on.

It has been found that if a bell constructed of pure lead is subjected to such a low temperature, it has a pure metallic ring when struck a sharp blow. Bits of vegetable matter immersed in liquid air become so hard and brittle that they may be powdered in a mortar. In the laboratory of the British Royal Society, it was found that the bacteria could not be destroyed even by the lowest temperatures.

The "absolute zero" has been set by physicists as being 273° Centigrade below zero (459.4° Fahrenheit below zero). In this condition matter will have absolutely no heat. The nearest approach to this has been in the liquefaction of hydrogen or —254° Centigrade (—425.2° Fahrenheit).

Transforming a Railroad Water-Tank into a Home for Two

AN OLD water-tank in a Western town stood idle until an enterprising citizen came along and recognized in it the making of a home for himself and his wife.



Love in an abandoned railway water-tank. There is even an upstairs and a guestroom in this improvised home

He set to work with carpenter's tools, and in a week he had the interior fitted up comfortably. He cut windows where he wanted them and made a door large enough for the champion tall man in the United States to walk through without ducking his head.

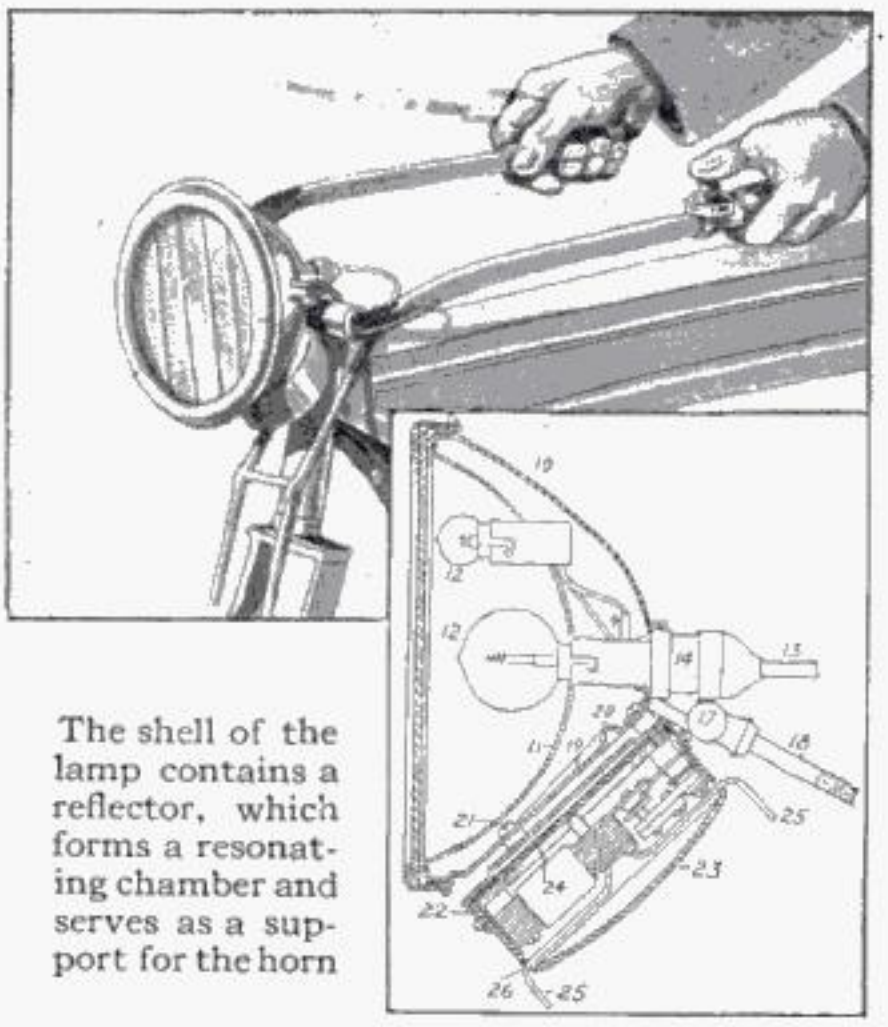
To disguise the tank-home as far as possible and also to add an element of architectural beauty to the whole, he fitted the roof with extensions, placing windows in the extremities.

This gave him the happy thought of building an upper room to the structure. Now he has plenty of room for guests, since he has finished off and furnished the addition as a spare chamber. A chimney was also added and stoves were installed.

A Combination Lamp and Horn for the Motorcycle

ONE of the newest attachments for motorcycles is a combination horn and lamp to be fastened to the handlebars, the shell of the lamp forming a base for the support of the casing of the horn. It is the invention of Perrin B. Whitney, of New York city.

The shell of the lamp is round, as shown at 10 in the detail, and contains a reflector 11, which is so constituted as to form a resonating chamber for the horn. One or more light bulbs, 12, are also contained in the shell, and connecting wires, 13, pass outward through a specially arranged socket 14. A portion of the shell is flattened into disk-shape, 19, from which a number of short posts extend to the axis of the shell. To these posts the cylindrical casing which is the container for the horn is secured. This casing may be closed by a lid, or cover, 23, through which the wires, 25, leading to the electric vibrator 24, of the sounding device, extend.



The shell of the lamp contains a reflector, which forms a resonating chamber and serves as a support for the horn

The construction is very compact and simple. The sounding qualities of the horn are greatly intensified by the resonating chamber provided by the lamp shell. The device is adapted for use on automobiles and other vehicles as well as for the motorcycle, the shell being provided with means to attach it wherever desired.

Money Prizes for Motorcyclists

Send In Your Kinks

IF you are a motorcyclist, if you have devised simple ways of making repairs, if you have improved your machine in any way, this will interest you.

The POPULAR SCIENCE MONTHLY offers a first prize of $25, a second prize of $15 and a third prize of $10 for articles in which motorcyclists will describe and illustrate the methods which they have successfully employed for overcoming trouble, for making quick repairs by the roadside or more difficult repairs in the shop, or for making attachments whereby the use of the motorcycle has been broadened.

The three prizes will be awarded by the editors of the POPULAR SCIENCE MONTHLY in the order of merit. What is more, even though your article may not win a prize, the editors may buy it at the usual rates, just because it is so good.

There are no limitations to this prize offer. We don't care for fine phrasing, but we do care for good mechanical ideas. Rough pencil drawings or photographs will do for illustrations.

The following conditions are to be observed:

(1) Articles must be written on one side of the sheet only.

(2) Write your name and address in the upper right-hand corner of the first sheet.

(3) Enclose postage for the return of the manuscript.

(4) Don't send in articles on ideas which have already been published.

(5) Don't send paper ideas—things that you haven't actually done yourself.

(6) Address the envelopes containing articles to

"Motorcycle Contest Editor"
POPULAR SCIENCE MONTHLY
239 Fourth Ave., New York City

The contest will close on December 31st, 1916.

The money for the prizes will be paid promptly after the awards have been made.

FOR PRACTICAL WORKERS

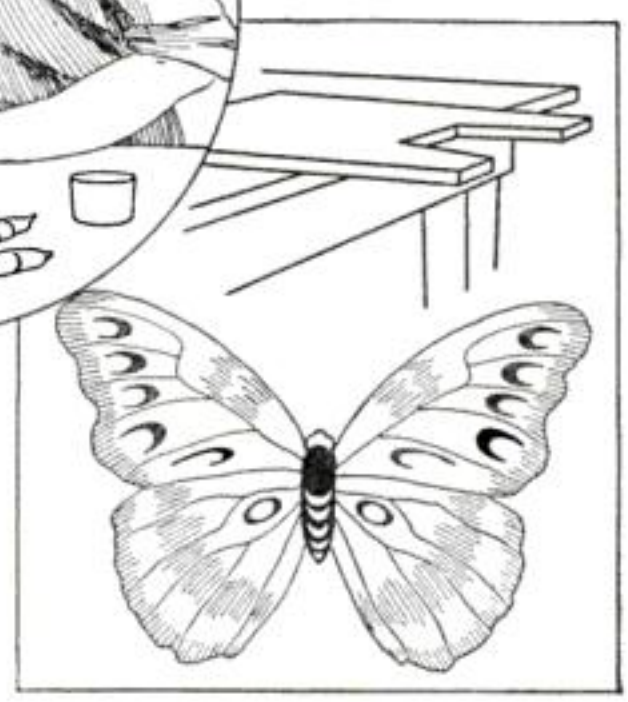
Making Artistic Decorative Butterflies in Sheet-Copper

TO produce artistic effects representing butterflies in copper requires a little skill, a sheet of copper—about 20-gage—a jeweler's saw-frame and blades, artist's oil colors ground in light Japan, two camel's-hair brushes—one wide and the other pointed—and a fine drawing-pen known as No. 390. The colors of paints and inks used depends upon the design to be executed.

Select the butterfly, or a colored drawing of one, to be reproduced in metal and very carefully trace or draw the outline on a piece of the copper. Saw it out, following the outline closely. Hold the copper in a bench-vise, or by means of a bench-angle, such as used by jewelers, or like that shown in the illustration. If the saw tends to bind or chatter rub a bit of beeswax or common washing-soap along the teeth. Smooth the edges of the copper pattern with a fine flat file and go over the surface with very fine-grained emery paper.

The coloring is next in order. Suppose, for example, the butterfly to be reproduced is yellow with black-lined wings and body. Squeeze a little of the yellow oil-color on a piece of glass and mix it to a fairly thin consistency with the Japan drier. Dip up a good brush full and flow it evenly over the entire surface of each side with the widest brush, allowing one side to thoroughly dry before touching the other. Choose the smoothest side and with a well-pointed pencil trace very lightly the general markings on the wings and body; then with a pen and ink, copy the markings of the original as closely as possible. This ink will dry almost instantly and leave a dull surface. If a glossy surface is desired give it a coat of very thin white shellac. Spots of contrasting colors can be touched in with the smaller brushes.

An assortment of these varicolored flies will make attractive pieces which can be utilized for many purposes, such as bookmarks, pendants, etc. By soldering a buckle-strap to one side before painting, an attractive and original belt-buckle can be made. Solder a sharp nail to the under side and drive in one end of a stick stained green and use for a plant stick. Several of these plant sticks supporting an assorted lot of brilliantly colored moths and butterflies, placed among the leaves of potted plants furnish a beautiful and realistic decoration for a window garden. —L. B. ROBBINS.



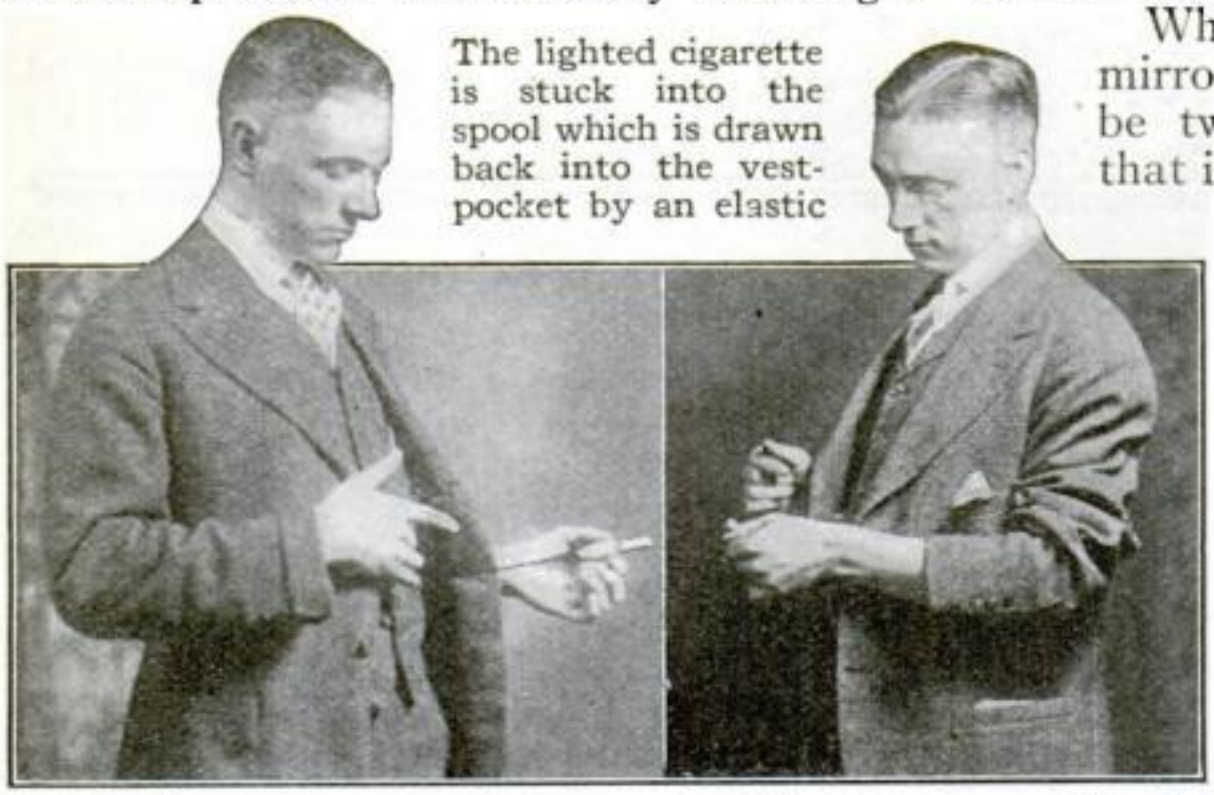
Coloring forms cut from sheet copper to resemble brilliant butterflies for decorative purposes

Repairing Automobile Tires to Prevent Bulky Places

BULKY-LOOKING repairs are often caused by the overlapping of the new plies of fabric on the old. When a piece of fabric is inserted it should lap just ⅛ in. all around. During vulcanization the air pressure and the expansion of the tire will draw the fabric down so that it will join the old fabric exactly without overlapping or any clumsy effect.

A Clever Trick Performed with a Lighted Cigarette

A CIGARETTE is lighted and tucked into a closed fist from which it vanishes while still burning. The effect is mystifying, but the method is simple. Take a wood spool and whittle away both edges so that it represents a tube, one end having a tapering point. Drill a hole crosswise through the tapering end; pass one end of an elastic cord about 2 ft. long through the hole and tie it. Tie the opposite end to a suspender button. The vest conceals this elastic, which when taut is just long enough to allow the spool to rest inside the lower vest-pocket.



The lighted cigarette is stuck into the spool which is drawn back into the vest-pocket by an elastic

The trick is performed as follows: Borrow a cigarette and reach with the left hand into the designated vest-pocket for a match. In pulling out the match take the spool with it, concealing it in the fingers. Stand slightly sideways so that the coat will hide the elastic. Tuck the lighted end of the cigarette into the hole in the center of the spool—it is just large enough to hold the cigarette snugly without extinguishing it. Open the fingers and the spool containing the cigarette will fly back beneath the coat.—MERRITT HALE.

Making Flexible Mirrors from Tinfoil on Celluloid

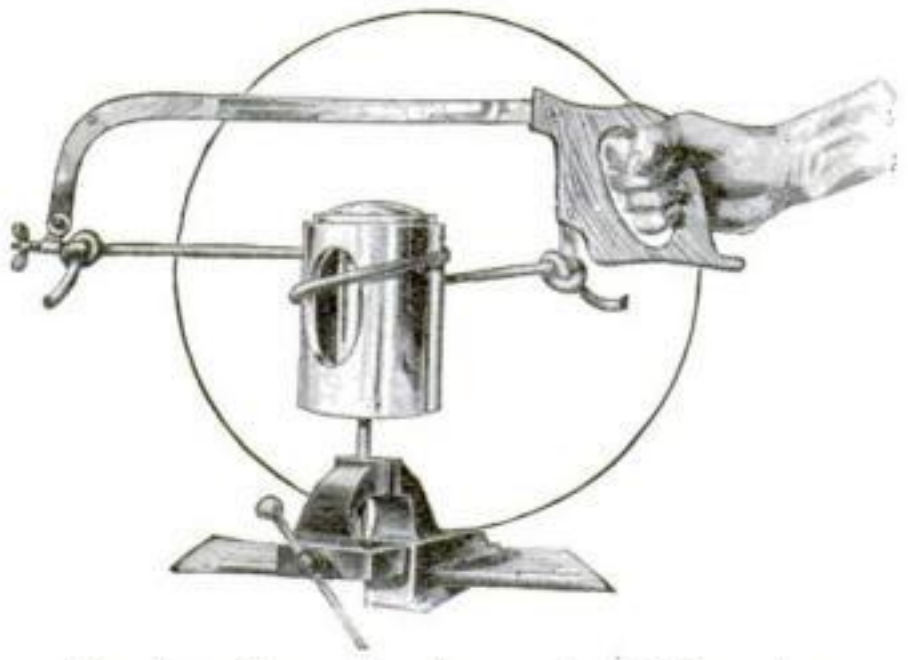
PROCURE a piece of celluloid—an old photographic film cleaned of the gelatin coating will suffice—and coat it as follows: Make a solution of ¼ teaspoonful of plain white gelatin in ½ cupful of boiling water. Take a piece of tinfoil—not lead foil—and rub a few drops of mercury or quick silver on one side until it resembles a mirror. Wet the fingers in the prepared gelatin, size and rub it all over the surface of the celluloid and lay the foil on, mercury-side down. Cover with a piece of newspaper. Hold it tight to prevent slipping, and burnish the foil down hard to the celluloid surface. This may be done with the end of a round paddle made of wood, or a similar hard surface.

When this has become dry a fine mirror will be the result. It may be twisted in almost any way so that it makes a very amusing device for distorting a person's reflection in all kinds of shapes, making tall people look ridiculously squat, and short, stout people look tall and lank.

Care should be exercised not to bend the celluloid too sharply as the foil will be wrinkled and the effect spoiled in consequence.

Grinding Automobile Engine-Valve Seats Set in a Sleeve

A SIMPLE and speedy way to grind automobile engine-valves set in a sleeve is to fasten the stem in a vise, take a length of rawhide and wrap it once or twice around the sleeve as shown in the illustration. Fasten the ends of the rawhide into a hacksaw frame and draw it back and forth the same as in sawing metal. A turning motion is imparted to the valve-sleeve, which will grind in a new seat quickly with the use of properly applied abrasives.



Turning the valve-sleeve about the valve stem in grinding the engine-valve seat

When fastening the stem in the vise be sure to use some soft metal on the jaws, such as copper or lead, to prevent injury to the surface.

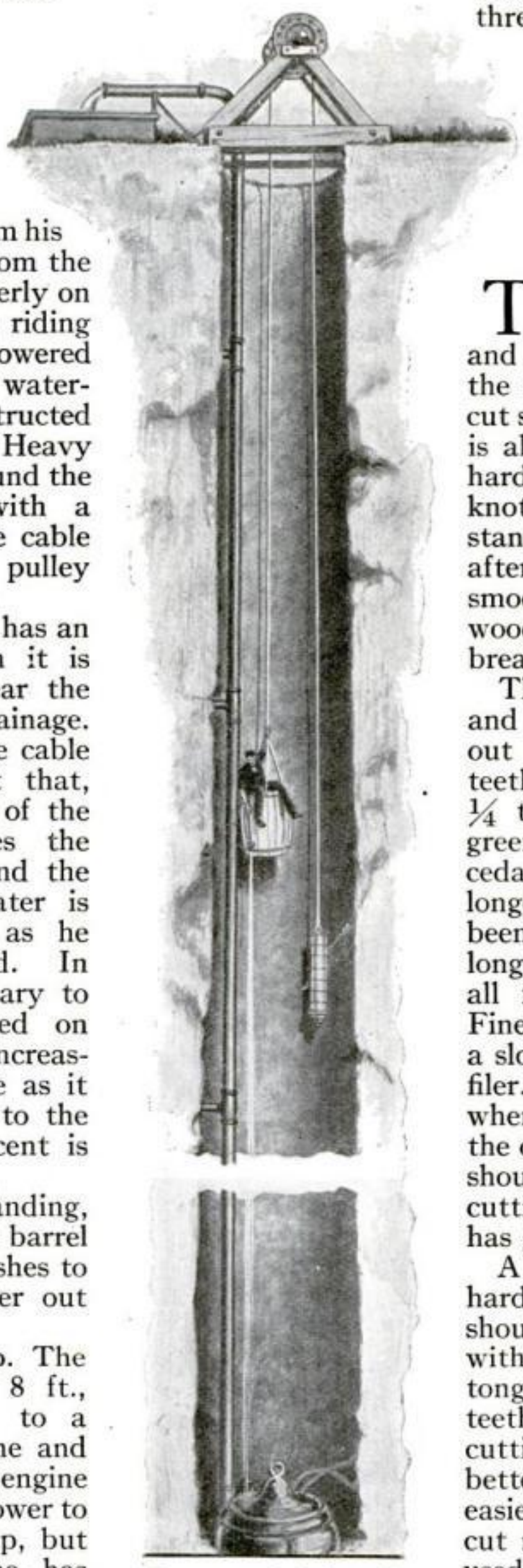
A Water-Barrel Elevator in a Well

AN engineer in southern California has figured out the simple but useful device of a water-barrel elevator, on which he rides to and from his work in a well 210 ft. from the surface. Two men formerly on the job lost their lives riding down in a large bucket lowered by a windlass. The water-barrel elevator was constructed in the following manner. Heavy iron bands were put around the barrel, and a bail with a swivel to engage a wire cable that runs through a pulley above was fastened on.

The top of the barrel has an opening through which it is filled, and a faucet near the bottom allows for drainage. On the other end of the cable hangs a counterweight that, taken with the weight of the cable, almost balances the weight of the barrel and the engineer. A little water is taken on for ballast as he starts slowly downward. In descending, it is necessary to have the faucet turned on enough to allow for the increasing weight of the cable as it passes over the pulley to the side on which the descent is being made.

After reaching the landing, the engineer fastens the barrel to a hook. When he wishes to return he lets the water out and rises to the top.

This well is 300 ft. deep. The shaft measuring 6 by 8 ft., extends down 210 ft. to a landing, where an engine and motor are placed. The engine was originally used for power to run a centrifugal pump, but since a high-power line has been installed it has been found cheaper to place a 100-H.P. motor, making 950 revolutions per minute, directly on the shaft of the pump, which hangs suspended 50 ft. beneath the surface of the water. It has three steps or vanes, and raises 110 in. of water through a 6-in. discharge-pipe into a tank on the surface.



On one end of the cable hangs a counterweight which almost balances the weight of the water-barrel carrying the engineer. An engine and motor are installed at the bottom of the shaft

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Secret of Success in Filing Cross-Cut Saws

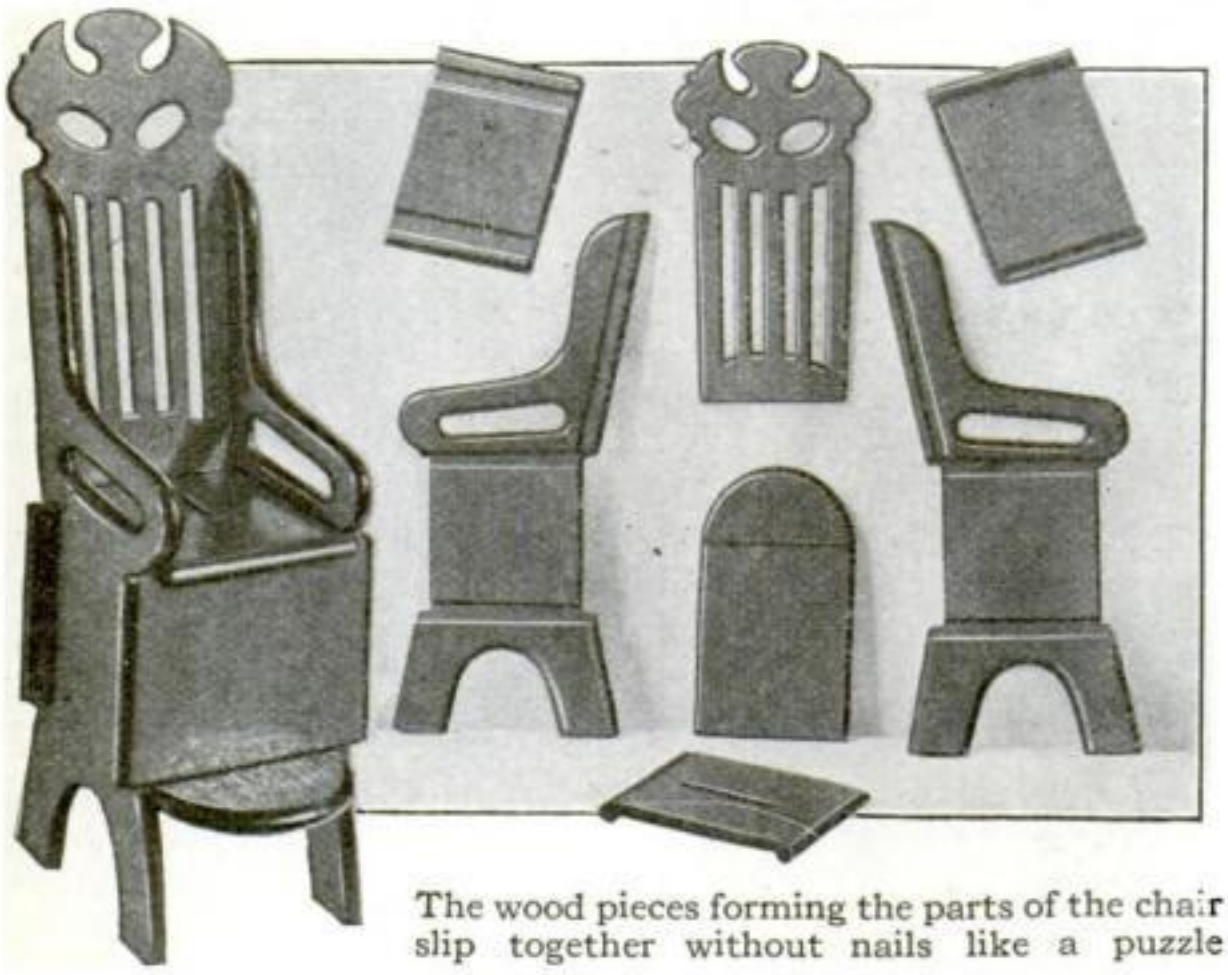
TO keep the cutting-teeth even and the points keen and smooth as a razor-edge is the main point in filing cross-cut saws. A rough-edged point is almost sure to break off in hard-grained wood, gnarls or knots. If saw-teeth points will stand the first two hours' work after filing, then they are worn smooth by the action on the wood and will not be likely to break at all.

The rakers must be swaged and adjusted so as to plough out all wood cut by cutting-teeth in strips or shavings from ¼ to 4 in. long although in green hardwoods, spruce and cedar the shavings will be much longer. Spruce shavings have been found to be 11 to 14 in. long. The idea is to eliminate all fine sawdust, if possible. Fine sawdust is a sure sign of a slow-cutting saw and a poor filer. Often the saw is blamed when the filer and sometimes the operator is at fault. A filer should be able to put a fine cutting point on any saw that has good material in it.

A saw that is so glossy and hard that it will not swage should have the temper drawn with a pair of thick, red-hot tongs. If possible all raker-teeth should be softer than the cutting-teeth. They will give better satisfaction and will be easier on the file; for a file will cut nicely on the bevel-stroke used on a cutting-tooth long after it has ceased to be of use on the hard horizontal stroke required in sharpening a raker, which must have a perfectly square chisel cutting-bit so as to plough out the sawdust.

A Toy Bank of Wood Fastened Together Without Nails

THE illustrations show a toy bank which is fitted and fastened together



The wood pieces forming the parts of the chair slip together without nails like a puzzle

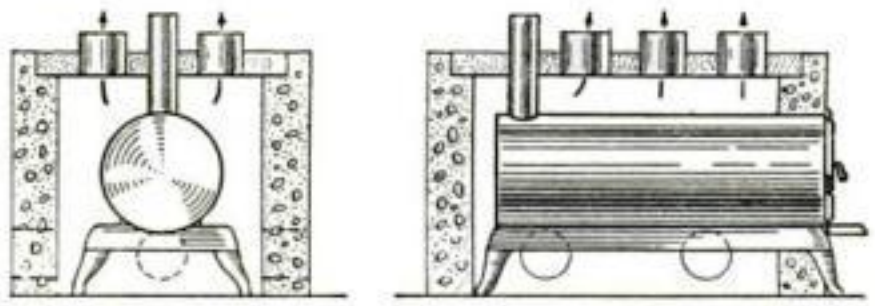
by checking and notching the several parts. The back of the chair is cut from a piece of wood 5 in. long by 2¾ in. wide and ⅛ in. thick. The sides are 7¼ in. long, cut from a 3⅞-in. board, ¼ in. thick. Each of these pieces is grooved for the back and cross-grooved for the top and bottom part of the box. The outline of these pieces is shown in the illustration. The width of the part that receives the front and back is 2¼ in. wide. The front and the bottom parts are shown at the right and left in the illustration, and are 3 in. long by 2½ in. wide. Each is cut from ¼-in. board, which is left full thickness at the ends; but in the center across the whole breadth it is reduced to ⅛ in. thick for a length of 2½ in. The seat of the chair is cut and checked the same way and to the same size and has the addition of the coin slot. The bottom which is shown in the center, is 3¾ in. long by 2¼ in. thick. This is cut with a wide end to form the step for the chair.

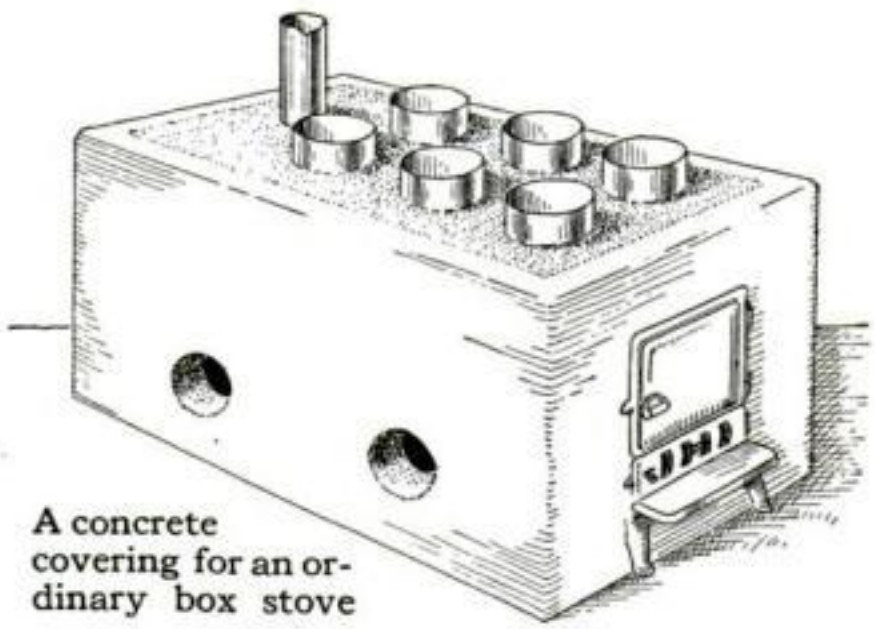
Put the parts together by placing the sides in position with the back piece keeping them apart. Slip the seat in place, then the front piece, and lastly the bottom piece, which is the key to the complete money-box. Add the upper back, which slides in between the grooves cut in the sides of the chair. The coins are inserted through the seat and are taken out from the bottom.—JOHN Y. DUNLOP.

Making a Wood-Burning Heater for the Home

THE drawing below shows a system of house heating where wood is the only available fuel. The temperature in the locality where this is in use frequently reaches 40 deg. below zero. The house is never cold in any room on either of the two floors, and the thermometer stands at 60 to 70 deg. in the morning after the coldest nights.

An ordinary box stove for 4 ft. cord wood is built into a rectangular jacket with walls 8 in. thick. An air-space of 8 in. separates the concrete from the stove at the nearest points. The top of the wall is recessed so as to leave a 4-in. shelf to support the galvanized sheet-steel roof. This steel top has sleeves for the smoke-pipe and heat flues, and is supported by two iron bars, equally spaced between the ends. The front of the stove is built in flush with the concrete, allowing access to fire and ash-doors. The expansion of the stove is provided for where it passes through the



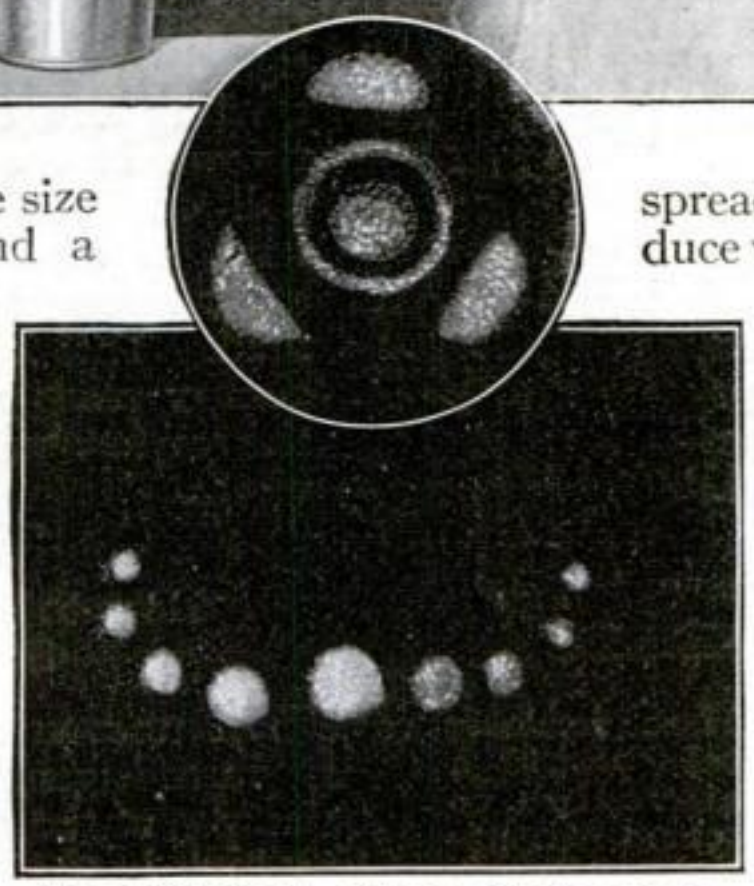


A concrete covering for an ordinary box stove

concrete, by a ½-in. jacket of asbestos which prevents actual contact between the stove and the concrete. About 3 in. of sand or loam is placed on top of the sheet metal. The heat flues at the top are connected with those running to the registers in the different rooms.—J. A. NORTON.

Making the Vibrations of the Voice Draw Designs

ONE of the most interesting of modern scientific devices is the eidophone. By means of this instrument it is possible to secure impressions of sound vibrations in a curious and often beautiful form. It is really easy to make a box which will enable one to draw patterns with the voice. A glance at the accompanying illustrations will show that the things necessary to produce this contrivance are few and simple. A tin saucepan of moderate size with a hollow handle, and a metal funnel will be required. These may be found about the kitchen of almost any home. The only necessary thing to purchase is a piece of sheet-rubber large enough to stretch over the top of the saucepan. Any kind of thin rubber sheeting will do, but the best for the purpose is that commonly employed for the making of toy balloons.



The vibrations set up by the voice produce beautiful designs in powder, chalk or glycerin on the rubber surface

With these materials gathered together start to make the device by opening up the handle of the saucepan. Any sharp metal tool may be used to penetrate the tin and the opening should be the same size as the inside diameter of the handle, so that it resembles a tube. Push the funnel-end well down into the inside of the handle. The rubber sheeting is spread over the opening of the saucepan and tied down firmly at the sides with a string. It is important to draw the sheeting until it is as taut as the head of a drum. The eidophone is then ready for use.

To make the experiments, some kind of a very light powder must be used. Very fine sand, precipitated chalk, or lycopodium powder, procurable at most drug stores, are all good. Whatever material is used should be spread in a thin layer on the rubber surface; then start to sing into the funnel a monotone note, steadily and continuously. In a short time it will be seen that the particles of the powder are busily arranging themselves into a design, which varies quite perceptibly according to the note sounded and the material used for the powder. An endless number of fascinating experiments can be carried on in this way. Colored glycerin can be used also, which when spread on the rubber will produce wavy patterns as the note is sounded in the tube. The only point to bear in mind is that in changing the substance on the rubber all traces of one material must be removed before another is put on.—S. L. BASTIN.

Friction Tape Used for Plaster Strips

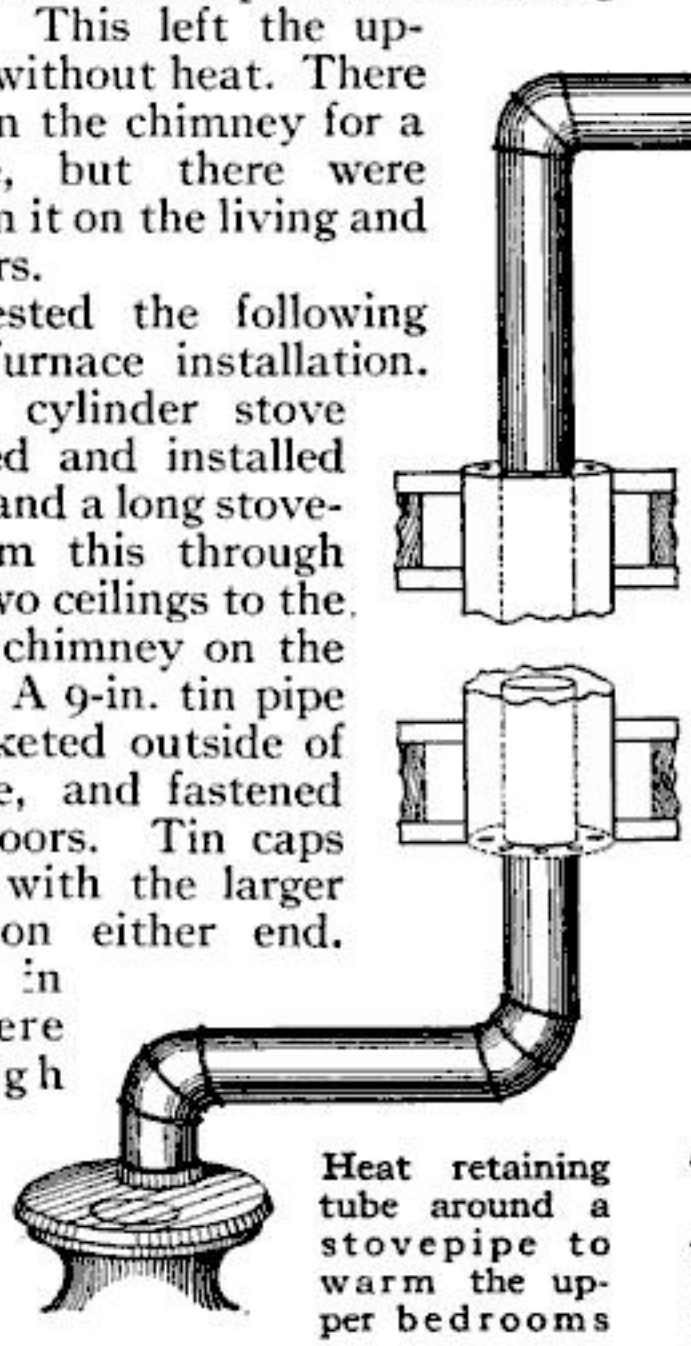
A "shop doctor" is called upon many times to bandage an injury while waiting the call of a regular physician. Adhesive tape is not always at hand, but usually some "friction" or "electricians' tape" may be had and can be used instead. This tape was tried out to keep a dressing on an ulcer on the heel of a sailor's foot during a long cruise. Almost the entire foot was well wrapped so that the man was enabled to walk the deck in his bare feet even when washing down. The tape being adhesive on one side provided a covering that was almost water-tight.

This tape has also been used in emergencies to make covers for dressing over hands and wristlets for sprained wrists. It is not preferred to zinc oxide adhesive tape but is valuable where the other is not at hand.—DR. OTTO SOMMER.

A Home-Made Heating Arrangement

NECESSITY required that a house built solely for use in summer weather should also be used as a winter home, and the problem of keeping from freezing during the cold months was solved finally by the home-made heating plant illustrated herewith. There was a cooking stove in the kitchen, which could be depended upon to keep the kitchen and a part of the living-room warm. This left the upstairs totally without heat. There was no hole in the chimney for a furnace pipe, but there were perforations in it on the living and chamber floors.

This suggested the following home-made furnace installation. An ordinary cylinder stove was purchased and installed in the cellar, and a long stovepipe run from this through holes in the two ceilings to the outlet in the chimney on the second floor. A 9-in. tin pipe was then jacketed outside of the stovepipe, and fastened in the two floors. Tin caps were bought with the larger pipe to fit on either end. Holes 1 in. in diameter were cut through these caps all around the circle. The object of these holes was to admit fresh air in the lower end of the pipe and to permit the hot air to escape above.



Heat retaining tube around a stovepipe to warm the upper bedrooms

When the fire was started in the stove in the cellar, the smoke and hot gas traversed the full length of the inner stovepipe, and in so doing heated all the air between it and the outside pipe. While the smoke and gas escaped through the chimney in the ordinary way, most of the heat which generally goes up the chimney was caught and radiated in the form of hot air in the upper chamber. Fresh air came up through the holes in the outer pipe in the cellar, and after traveling the full length of the distance from the cellar to the second floor it spread out as hot air to warm the bedrooms. The question of risk from fire was eliminated by using sheet asbestos wherever the pipes came near or in contact with woodwork.

Starting an Automobile When One Rear Wheel Is On Ice

THE owner of an automobile happened to stop his car where the front wheels were in some mud, one rear wheel on a bit of ice and the other on solid ground. The mud was not deep, but there was just enough to prevent the car starting from a standstill with one driver on a slick surface. Having no tire-chains on hand he tried putting some sacks under the wheels in which the chains were kept. These were thrown out behind the car as fast as they could be put under the wheel. He finally pulled out by having some one push while the clutch was thrown in action.

The trouble as mentioned could have been easily overcome without the driver getting out of the car or doing anything especially different from the usual if in starting the car on low gear he had thrown in the brake enough to cause a pull on both rear wheels. This would have produced a tractive effect sufficiently strong to get the car through the mud. This idea can be used in many similar cases where it is difficult to start the car for lack of tractive power on one wheel.

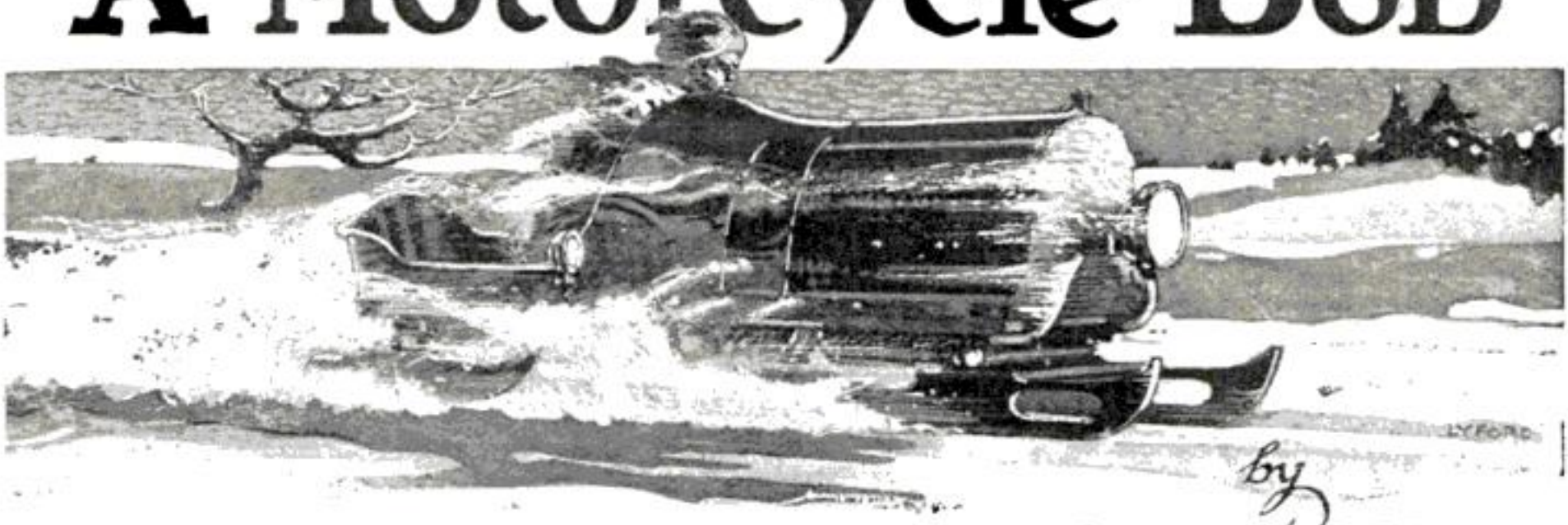
How to Make a Pendulum Swing Easily

THE uneven swinging of clock pendulums is generally due, not to incorrect balancing of the pendulum weight, but to a tiny kink in the feather-spring from which the pendulum is suspended. If the face of the clock is taken off, the feather-spring may be twisted slightly in the right direction with a pair of tweezers or small pincers. This will correct the unsightly wobble and help to maintain the perfect balance.—RALPH W. TILLOTSON.

Lifted Tread Sections in Making Automobile Tire Repairs

MUCH has been said about the lifted tread method of making a sectional tire repair, but many vulcanizers are still following the wasteful practice of cutting off the old rubber and throwing it away. Cut across the tread well to one side of the injury and peel it back. After the section has been built in, cement the tread and lay it back in place.

A Motorcycle Bob



by Frederic B. Hart

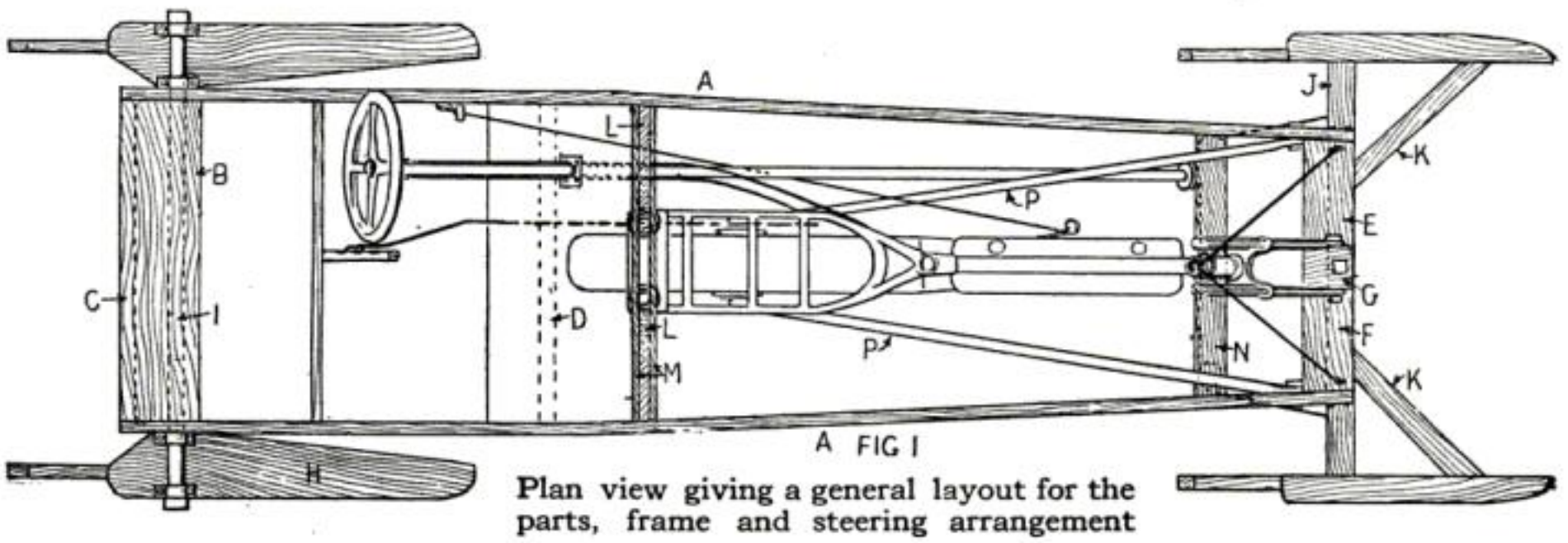
Convert Your Motorcycle into an Inexpensive Power Bobsled

IN designing this motor-bob it is assumed that the building will be done by motorcycle owners having limited facilities, therefore everything is made in the simplest form, of materials easily obtained. Except the woodwork, nothing is required beyond some pieces of 1-in. gas-pipe, a small piece of boiler-plate for the kingbolt support, some ⅛-in. outside diameter brass tubing and steel wire for the ignition and throttle controls, and some ⅜-in. rod and heavy strap-iron for the clutch-control and gear-shift. Many dimensions will have to be varied to conform with the motorcycle used for the power plant, so only general dimensions that are applicable to any machine are given, and even these may be changed to meet the requirements of the builder.

Only a general outline is suggested for a two-passenger seat and a hood for the motorcycle. If such a hood is used it should be open in front or covered with a wire screen. Vents for windows in the sides of the hood would be advisable.

Frame Construction

The frame is constructed like the three-point suspension used on automobile engines, one point at each rear runner and the other at the kingbolt. The frame sides *A*, Figs. 1 and 2, are made of oak or other hardwood, 4½ in. wide, 1¼ in. thick, and if the details of the drawings are adhered to, the length should be 9 ft. 9 in. The rear cross-member *B* is 30 in. long, 8 in. wide and 2 in. thick. There is a second rear brace *C* directly under *B* at the extreme end of the frame; this is 30 in. long, 4 in. wide and 2 in. thick. From this point the frame is somewhat narrowed, principally for appearance sake, and the front cross-members, *E* and *F*, are 24 in. at the forward edge and slightly tapered to conform with the lines of the frame sides. The cross-member *E* is 5 in. wide and 2 in. thick and the piece *F* is 2½ in. wide and 2 in. thick. At the center of the piece *E* is a block *G* 5 in. long and 2 in. thick, and with a width equal to that of the distance between the fork-ends on the motorcycle. Further de-



Plan view giving a general layout for the parts, frame and steering arrangement

tails of this block will be taken up in the order of construction for setting the motorcycle.

Rear Runners

The rear runners are built independently of each other and should be made of 1½-in. hardwood 44 in. long and 9 in. wide. Make the top plate *H* of 1-in. hardwood 36 in. long and 6 in. wide. These top-plates should be secured to the runners in such position that the outside edge extends about 2 in. beyond the outer face of the runner. Care must be taken that this plate is directly at right angles to the runner. Put a triangular brace directly under the supporting tube as shown in the dotted lines in Fig. 3. As these runners must have a free movement to pass over obstructions they are not attached directly to the frame but to the axle-tube *I*, Fig. 1. The axle is

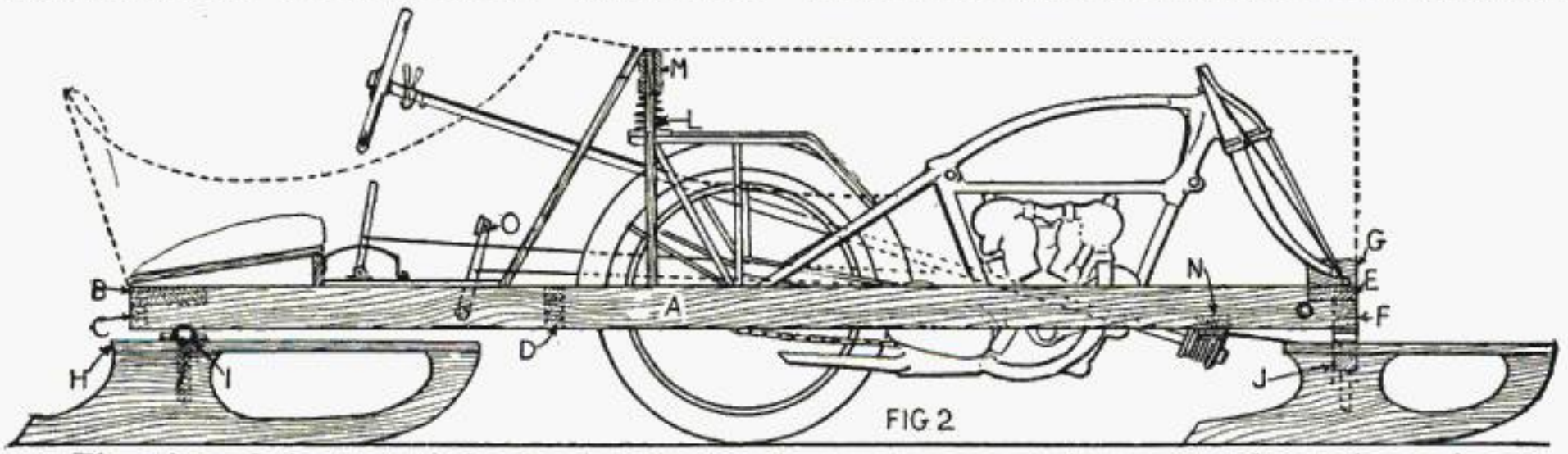


FIG 2

Elevation of the motor-bob, showing the location and parts of the motorcycle used, steering arrangement and main frame with dotted line designating the outline for a body and motor-cover

a piece of 1-in. gas-pipe, or, if preferred, a piece of 8-gage steel tubing 1¼ in., outside diameter. Make six stirrups out of 1-in. by ⅛-in. strap-iron. Two of these are used for securing the tube to the frame sides, the other four for securing the runners as indicated in Fig. 3.

The stirrup-clips for securing the runners to the axle-tube must be loose enough to allow the runners to turn on the tube. Thread the ends of the pipe and screw ordinary pipe-caps thereon to hold the runners in place. The outline of the runners should be long and flat, about as indicated. These may be either solid or cut out as suggested in the illustration.

The Front Runners

Build up the front runners as one unit with each runner 36 in. long, 9 in. wide and 1½ in. thick. Make the flat part of these runners about 24 in. long to facilitate turning the front part in steering. The center crossbar *J* should be of hardwood 42 in. long, 4 in. wide and 2½ in. thick. In the center, for a distance of about 7 in. use the full width of the piece, then cut on an angle to 3 in. in width as shown in Fig. 4. At a distance 20 in. from the front end of each of the runners cut a notch 2½ in. wide and 2 in. deep to receive the ends of the crossbar *J*, Fig. 1. The top-plate of the front runners is 2 in. wide and 1 in. thick. As a part of the crossbar ends projects 1 in. above the top of the runner this must be removed so that the plate will set on the runner-top and come level with the crossbar surface. To further stiffen the runners laterally, triangular braces similar to those in the rear runners are set as shown in Fig. 4. Diagonal braces *K*, Fig. 1, must be added to stiffen the runners for steering.

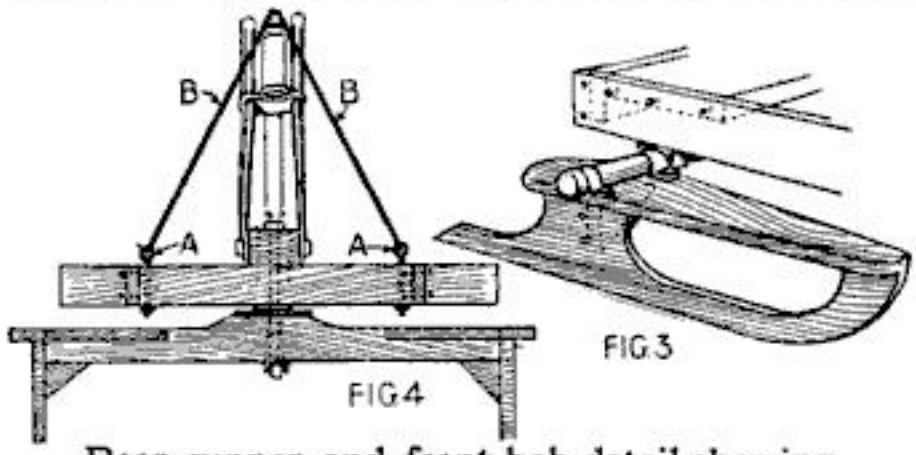
The frame and the front runners are pivotally connected by means of a kingbolt which should be about 12 in. long and ¾ in. in diameter. It is located 1½ in. from the front of the frame and directly in the center, where a vertical hole is bored through the pieces *G*, *E* and *F*. In the center of the crossbar *J* of the front runners drill a hole large enough to receive the kingbolt and taper it outwardly toward the bottom so that there may be some play for the bolt.

Cut from a piece of boiler plate, or any ¼-in. steel, a plate 6 in. long and 2½ in. wide. In the center of this make a hole to receive the kingbolt. Near each corner of the plate, drill and countersink holes for ¼-in. wood screws. These are used to secure the plate to the crossbar *J*. Between the plate and the frame member *F* place a large washer to further facilitate the turning. Put on a similar washer at the lower end of the kingbolt and finish with either a large nut or cotter.

Mounting the Motorcycle

Having proceeded thus far the chassis is ready for the motorcycle. Remove the

front wheel of the machine and all the movable parts of the spring-fork, leaving only the main fork as shown in Fig. 2. Bore a cross hole through the block *G* just back of the kingbolt and secure the fork to the block by means of the front axle. To maintain the motorcycle in a vertical position make the support as follows:



Rear runner and front-bob detail showing the plan of teetering and tilting devices

Make two eyebolts, *A*, Fig. 4. These bolts should be at least 6 in. long as they are used for adjusting the stay-rods *B*. These stay-rods are made with an eye at the lower end for linking into the eyebolts *A*. Bend the upper ends into a hook to engage the fork stem. Place these in position as shown and tighten the nuts at the lower end of the bolts *A*, so that the motorcycle may be readily adjusted and secured in a perfectly vertical position. Do not use continuous rods for this purpose, as there must be a hinge-action at the eyebolt to allow for the vertical movement of the rear wheel of the motorcycle.

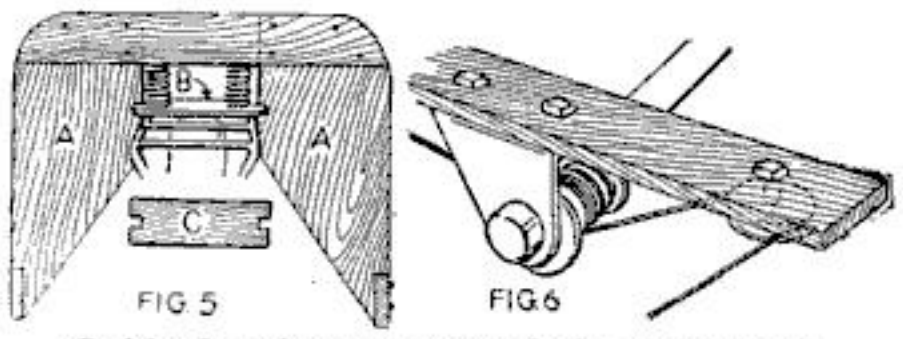
The rear of the motorcycle is supported by the brace *L*, Figs. 1 and 2, which is shown in detail in Fig. 5. Make two guides *A*, and secure them to the frame sides by means of screws or bolts to allow an opening between the guides just wide enough to bear against the luggage-carrier. The crossbars, *M*, Figs. 1 and 2, should be located at least 4 to 6 in. above the top of the luggage-carrier. Cut a crossbar *B*, Fig. 5, from a piece of hardwood ¾ in. thick and notch it at the ends as shown in the detail *C*, making them wide enough to let this bar move freely on the guides *A*. Between *B*, Fig. 5 and the crossbars *M*, Fig. 1, insert two spiral springs each strong enough to exert an initial pressure of at least 25 lbs. and preferably 50 lbs. when in position. The purpose of these is to prevent the motorcycle from jumping up and down when running over obstructions.

To transmit the driving force from the motorcycle wheel to the bob take two pieces of ½-in. gas-pipe, or 1-in. No. 16-gage steel tubing, flatten them at the ends and drill one end to fit over the rear axle ends. Let these tubes extend forward as shown at *P*, Fig. 1, bolting the forward ends to the frame sides close to the front ends. It will be readily seen that without these braces the drive would be transmitted to the sled through the front forks which should not be subjected to such strain.

Steering Apparatus

Steering is accomplished by means of a wheel. The steering post may be constructed of 1-in. gas-pipe and the wheel may be simple or elaborate, according to individual taste. At the lower end of the pipe secure a spool of hardwood about 3 in. in diameter with about 1 in. of the pipe projecting beyond the spool. On the crossbar *N*, Figs. 1 and 2, place a piece of flat iron about ¼ in. thick as indicated, thus furnishing the support for the lower end of the steering post. Run a pin through the end of the pipe or screw on an ordinary pipe-cap to prevent the post from backing out of the collar-plate. Support the upper end of the steering post by passing the post through the upright guideway at the rear of the motorcycle. The detail is shown in Fig. 6.

A piece of ¼-in. cable wire is anchored solidly to the spool and two turns of it are run around the spool each way from the anchor and wrapped so that the wire will leave the spool in each direction from the bottom. Pass these wires around grooved pulleys pivoted on the ends of the crossbar *N*, Fig. 1, and thence to the crossbar of the front runners. It is readily seen that by turning the steering wheel to the right the right end of the runner will be pulled backward and the motor-bob will steer to the right, and vice versa.



Guide for the rear part of the motorcycle and steering-cable supporting connections

The Controls

The question of control is a matter to be determined by the kind of motorcycle used, and only general suggestions will be offered. The spark and throttle can be

best operated by means of a spring-steel wire working inside of a ⅛-in. outside diameter brass tubing. A suggestion for the construction of this is shown in Fig. 7. If the levers and tubes were secured directly to the steering post they would necessarily turn with it, but if a piece of steel tubing that loosely fits over the steering post is slipped in place and the lower end secured

FIG 7

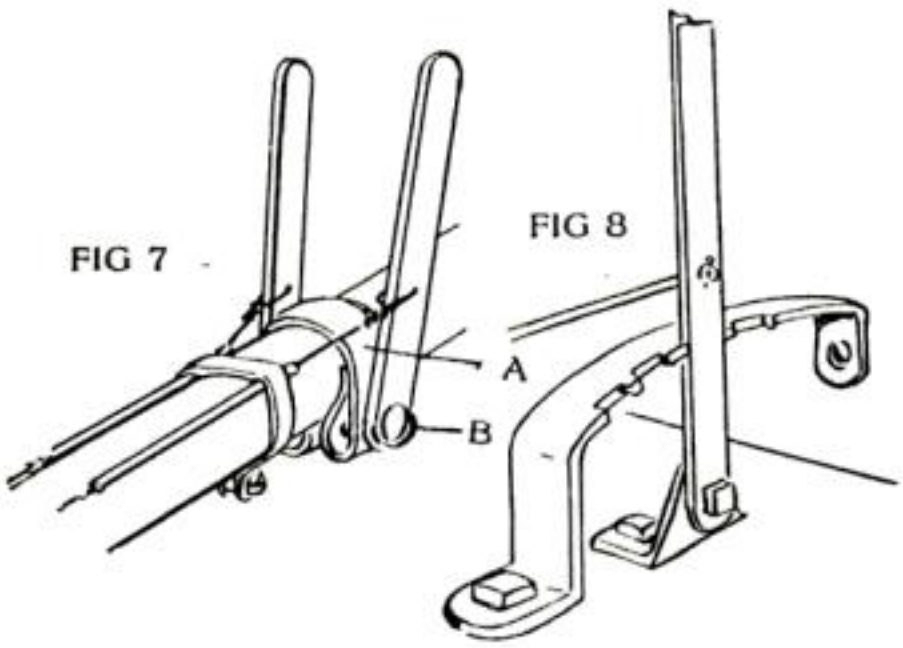


FIG 8

Motor-controlling lever attachment to steering post and clutch-lever quadrant

either to the sloping footboard or to the wheel guide *L*, Figs. 1 and 2, the steering post can be turned inside the tube without interfering with the controls.

The clip *A*, Fig. 7, is looped as indicated so that when the cross-bolt *B* is drawn up, the loops of the clip will bind on the under side of the tube, thereby holding the clip in place without drawing the bolt *B* so tight as to interfere with the movement of the levers. Secure the upper end of the two pieces of ⅛-in. brass tubing to the steering post about 2 in. below the levers by means of a single metal strap or clip. Run these tubes down the steering post and then to the throttle and spark controls, securing the ends to some nearby part of the machine; then run the wires through the tubes, securing them to the steering-post levers and the throttle and spark levers in any convenient manner.

For the length of time the motor-bob will be used, a reasonably satisfactory connection can be made by simply looping the ends of the wire through the holes in the levers and wrapping the ends around the main wire as shown. For the gear-shift, make a lever and segment as shown in Fig. 8, notching the segment in proper position for the gear-setting. Disconnect the gear-shift mechanism of the motorcycle and run a ¼-in. rod from the lever to it.

For clutch operation, make a lever as shown at *O*, Fig. 2. Bolt this to the frame side and let it come upward through the floor. Connection between this and the clutch-lever should be by means of a ⅜-in. rod or steel tube. If the clutch can be made to operate by a pull instead of a thrust, then extend the lever below the pivot so that the operation may be by means of a wire fastened to the lower end of the lever.

No special instructions have been given as to means of joining the various frame parts and a wide leeway has been allowed for individual ideas and facilities.

Filtering Gasoline Through Chamois a Dangerous Performance

FROM a well known authority comes the statement that to strain gasoline through chamois is dangerous for the following reasons: When gasoline is poured on a chamois, static electricity is created and it is apt to fire the liquid. As long as the funnel fits the tank opening a ground is formed and there is no spark, but, if for any reason the funnel is held up or is not in contact with the tank, a spark is likely to jump across from the funnel to the metal of the tank with disastrous results.

The funnel is held up by the seat board but a spark may jump the gap into the tank

Many tanks are set into the seats of the automobiles, as shown in the illustration, consequently the passing of the gasoline through the chamois in the funnel sets up the static, and if a sufficient amount is stored up, a jump spark issuing between the funnel and the tank will be likely to cause a fire with serious results.

Photographic Printing Masks Easily Made

PRINTING masks are easily made from the black paper found in all negative boxes. After determining the size of opening desired, a rectangular mask is cut as follows:

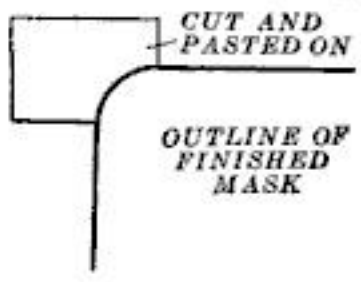
Take a sheet that is large enough to fully cover the negative and fold it two ways to make four thicknesses. Make the folded edges exactly even with each other—they will then be perfectly square. Lay off at right angles to the shorter fold, one-half of the longer dimension of the opening desired, and mark, preferably by nicking the folds with the point of a sharp knife. Do the same with one-half of the short dimension on the other folds. Lay a straight edge (an old negative will do), on the nick. Repeat the measurement to the straight-edge at the outer edge of the folded sheet. Nick this with the knife. Draw a fine pencil line between the two nicks. Repeat with the remaining measurement. Cut along the straight edge from the pencil line to the nick. Cut at right angles along the pencil line from the first cut to the nick. When opened up, a true rectangle of the required size is obtained.

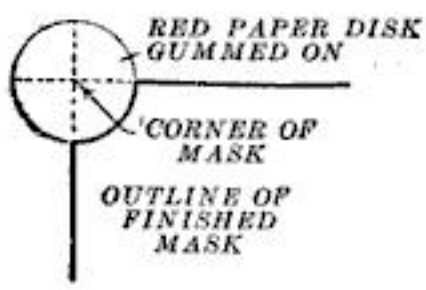
It may be improved by moistening between two damp blotters in the press till the folds disappear. A number of modified corners may be devised for use with such rectangles by the aid of the red paper seals sold by stationers, or a little ingenuity will enable the operator to cut these designs from the black paper with scissors.

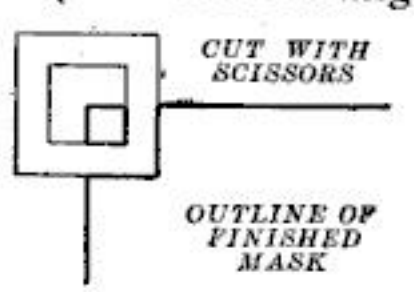
Oval, elliptical, or circular masks, can be cut with shears, after laying out one-fourth of the figure as shown in the illustration. Finally, any special shape, symmetrical about one axis, can be laid out with pencil on a doubled sheet (the fold forming the axis) and cut with shears. The results, after a little practice will be absolutely satisfactory, and will be endless in variety.

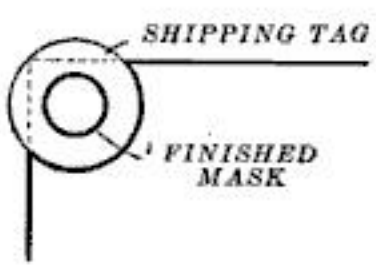
For larger sizes, the various geometrical figures can be laid out with accuracy by the use of drafting instruments. Directions for describing all ordinary geometrical figures can be found in almost every engineer's hand-book.

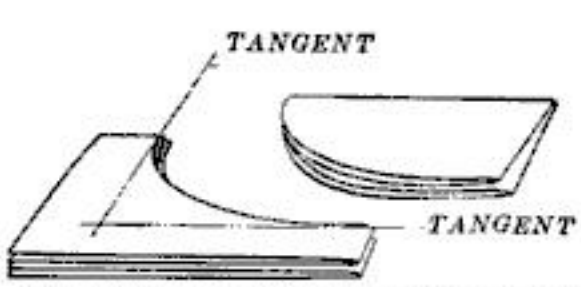
To describe an ellipse, however, with little trouble, requires only a rule, two pins, a piece of string and a pencil. Having determined the length and width, draw two axes at right angles. The intersection is marked *A* in the diagram. From *B* lay off



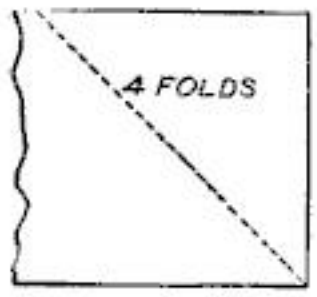


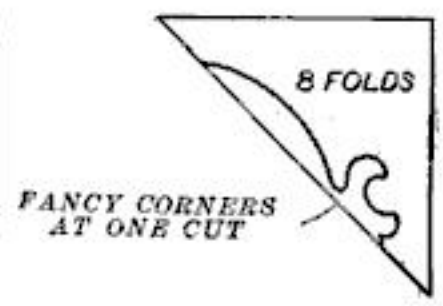


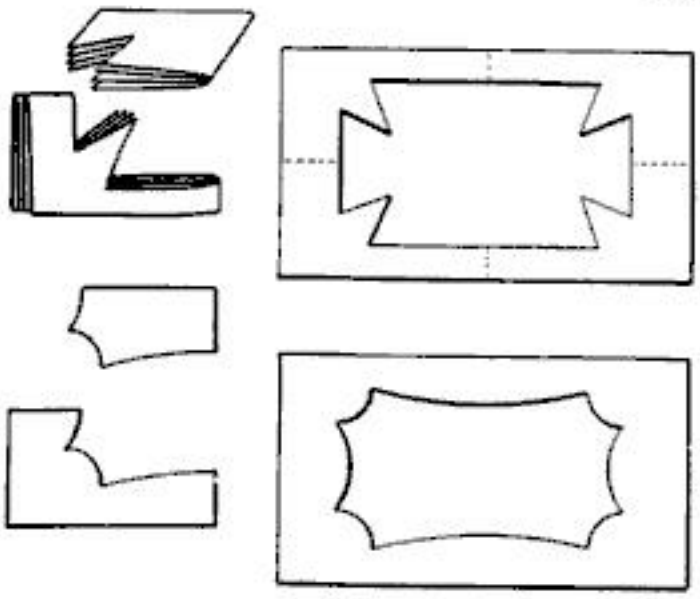


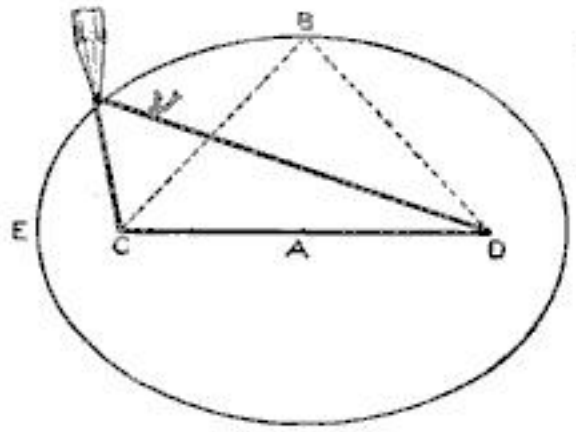


ELLIPTICAL MASK MADE WITH ONE CUT OF SHEARS

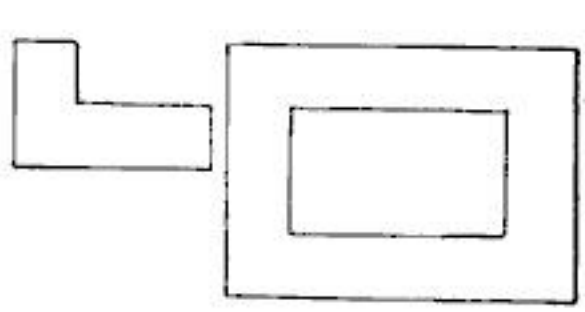








A TRUE ELLIPSE WITH TWO PINS AND STRING



KNIFE FOR CUTTING MATS AND MASKS

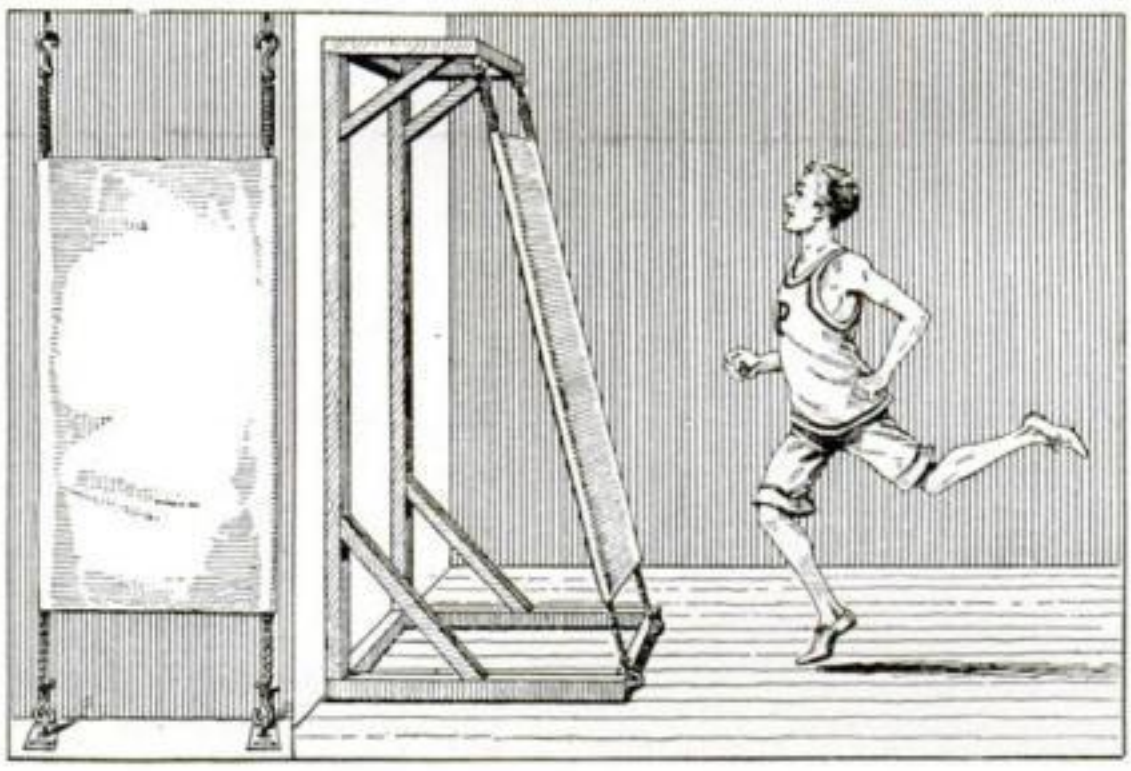
All patterns for making cut-outs and fancy corners for photographic masks are easily formed with a four-fold paper, cutting all the quarters at the same time with a pair of sharp scissors

BC and *BD* equal to *EA*. Stick in a pin at *E* and *D*. Tie a string around the two pins in a loop which, when pulled tight by inserting a pencil point as shown, will lie on the triangle *BCD*. If the pencil point is now moved carefully around the two pins, keeping the string stretched taut, it will describe the required ellipse.

Thin mats, masks for passe-partout, etc., can also be cut by this method. Always press between damp blotters, and afterward between dry ones to remove the creases. It cannot be used, however, on material thick enough to crush or break when folded, without marring the work. In this case the work should be laid out on the back of the mat with a pencil and cut carefully to outline with a sharp knife. A penknife is not a suitable tool for thick mats. The best tool for the work is a common one-piece steel table knife, broken within 1½ in. of the handle and ground to a dagger point.

A Buffer to Stop Sprinters in Indoor Sports

TO take the place of large gymnasium mats, or a wood track with an elevation at the end to retard the speed of sprinters in indoor sports the arrangement shown in the illustration has been devised. It consists of a framework to set against the wall with a base and top extension for attaching a canvas buffer. The framework should be of a size to hold a canvas 6 ft. long by 3 ft. wide, with suitable ropes hemmed in at the sides of the canvas and their ends extending for fastenings. The lower ends of the ropes are provided with hooks which catch into rings on the base or into plates fastened to the floor. The upper ends have a coil-spring and a hook on each one to make attachment to the top of the frame or ceiling.

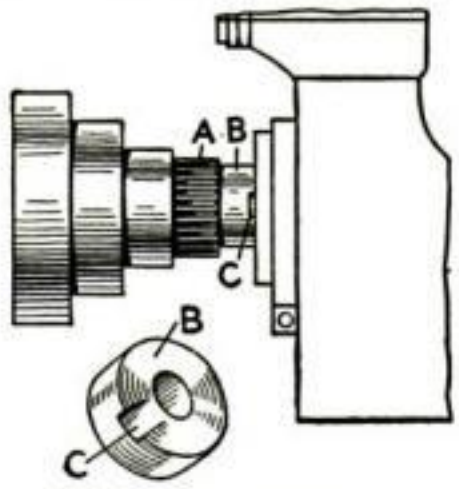


A frame built up to hold a canvas for stopping indoor runners

Athletes running strike the canvas with a turn so that it throws them back lightly on the track. The frame is not necessary where there is a low ceiling, as the hooks may be attached directly to the floor and ceiling.—A. B. WEGENER.

Removing Collar on Change-Gear Spindle of Lathe

TO change over gears for compound trailing on a lathe to cut threads it is necessary to remove the belt-cone and reverse the gear *A* and collar *B*. The collar is difficult to remove because of its smoothness and its close fit to the boss face on the lathe head. This may be easily accomplished if a small groove is filed in the collar at *C* sufficiently deep to take the end of an ordinary screwdriver.—C. ANDERSON.



Groove for easily removing collar when using compound gears

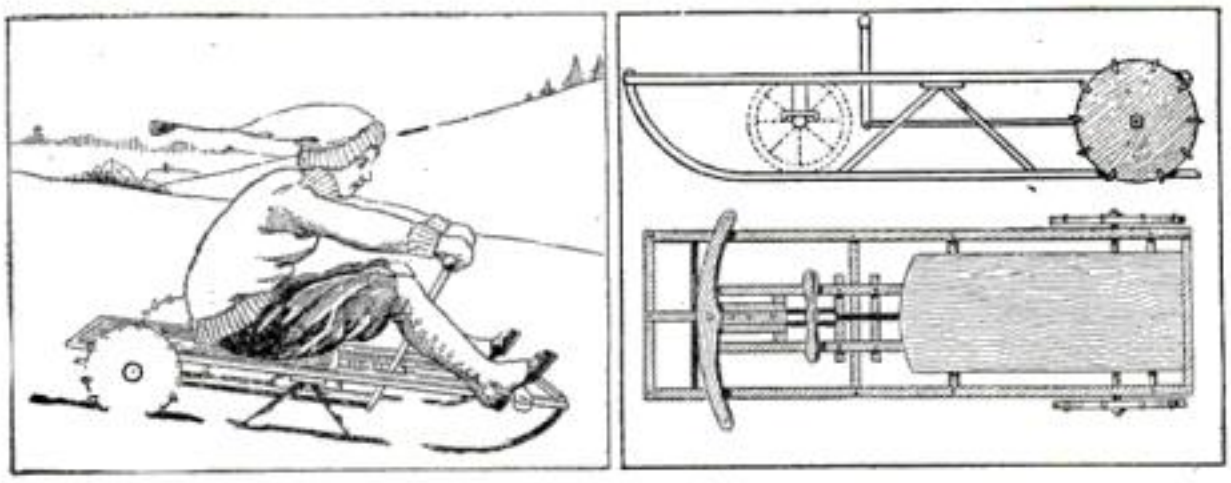
Making Extended Index Tabs for Books

TAKE a piece of heavy, gummed paper tape 2 in. wide by about 14 in. long and fold it in the center lengthwise. Cut a piece of cardboard ¼ in. wide and 14 in. long. Dampen one side with a sponge and lay it on the tape against the crease. Dampen the remaining side and fold over the other wing of the tape. When dry, cut into ¼ in. widths, moisten the gummed wings and insert the sheet to be indexed, pressing it down tight. The extended portion may be lettered alphabetically or otherwise, according to individual taste and the use to which it will be put.

While this may not look so well as a leather index from an artistic viewpoint, it will, nevertheless, prove very serviceable and the cost of the materials from which it is made is almost nothing.

Changing a Boy's Handcar into a Mechanically Propelled Sled

THE ordinary handcar sold at almost any toy store, or the car operated by foot pedals, is not of much use when 1 ft. of snow covers the ground, and it is usually stored away until milder weather returns. The sled takes its place in outdoor sports, but coasting down hill and sliding across the ponds does not, after all, take the place of a motive power that can be kept up indefinitely on the level, whether on the ice or snow.



If the front wheels are removed from the handcar it can be securely fitted over an ordinary steerable sled with room enough to accommodate the driving wheels

The ordinary hand or foot-pedal car can be mounted on runners and different wheels substituted, and an ordinary steerable sled can be fitted to it with little trouble. First remove all four wheels from the handcar, then fit the sled over it and fasten it down firmly with a few bolts. The handcar stripped of its wheels is so much smaller than the average steerable sled that little trouble will be found in fitting them together. It may be necessary to use a few blocks of wood here and there to bring the parts into a snug, firm fit.

The main thing is that sufficient room should be made on either side to accommodate the rear driving-wheels. These are fitted to the axles of the handcar, and may be made from solid pieces of wood 1 in. thick. The rim of the wheels when placed on the axles should clear the ice by about ⅛ in. when the sled is standing on its runners. By measuring this distance the wheels can be made the right diameter. Find the exact distance from the hub to the ice, and then with a string form a circle on a board from which the wheel is to be cut.

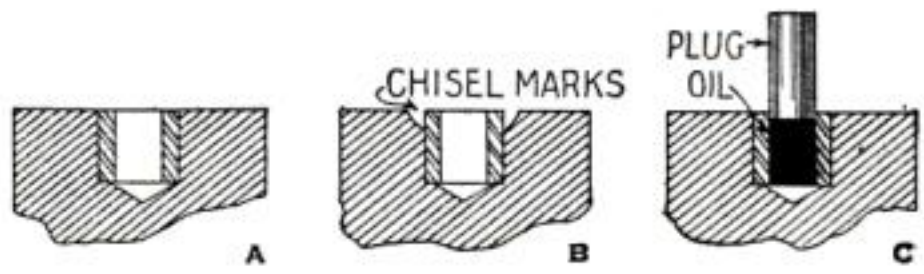
Cut out the circle with a compass saw, then make ten 1-in. notches around the rim at regular intervals. Hard wood only should be used for the wheels or they will not stand the strain. Into the notches made in the rim small galvanized pieces of iron are inserted with their sharp points projecting outward and forward. These points are the buckets which give tractive power to the sled when on the ice. If this method is too elaborate ordinary 1-in. screws may be used, inserted half their length into the wheel, and then filed so a point will be formed. Even ordinary heavy nails can be used, driving them in firmly, and filing off the heads to a point.

The sled is intended to rest on the runners, but the brads of the driving-wheel touch the ice or snow and give tractive power. When the hand or foot-pedals are worked, the tractive or driving-wheels revolve, and the brads digging into the snow or ice will give propelling power. If the back wheels are nicely adjusted, three times the speed may be obtained from the motor sled than from the handcar. The reason for this is that there is less friction to overcome. Ice or hard snow may be crossed with ease, and it will even climb small hills.

Everything depends upon the adjustment of the driving-wheels. If the brads project more than ⅛ in. below the runners they will impede the progress.

Removing a Bushing from a Blind Hole

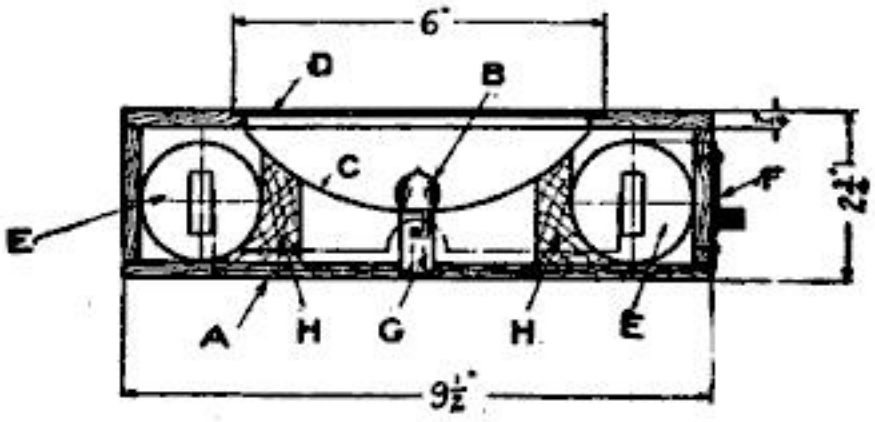
OFTEN it is necessary to put a blind bushing in a fixture for gaging purposes, the bushing being pressed in as shown at *A*; then before the job is complete it may be required to remove the bushing, through some error. The usual method of removing the bushing is shown at *B*. A very effective way is shown at *C*, wherein oil is run in the hole and a close-fitting plug or plunger driven in with a hammer. The compress oil forces the bushing out and there is no danger of damage being done to the parts.—A. H. WADELL.



Two effective methods of removing close-fitting bushings in fixtures and jigs

A Dark-Room Lamp to Be Used Under a Glass Tray

THE lamp illustrated is a very handy instrument for developing plates and films. It consists of a light-tight wood box *A* containing a small lamp *B* and a reflector *C*. The size of the ruby



The developing tray of glass is placed on top of the ruby glass of the lamp

glass *D* depends upon the size of the plates used. There are two dry batteries *E*, about 6 in. long by 2 in. in diameter which supply the current for the lamp. The circuit is opened or closed by the switch *F*. Two wood blocks *H* keep the batteries *E* in their proper place and support the reflector *C*. The developing dish must be of glass and is placed on the ruby glass *D*. The dry plate or film is then put in the dish, the developer poured on and after about half a minute the lamp *B* is switched on for a few seconds. Without taking the plate out of the dish one can judge the development as the light is thrown through the ruby glass *D*, and through the bottom of the developing dish and the negative. This is repeated until development is complete.

Since the dark-room lamp described here is the only source of light in the dark-room, and is used only at intervals for a few seconds, there is no possibility of fog.

The dimensions given refer to a lamp for plates 4 by 5 in. The reflector *C* may be German silver and about 1/32 in. thick and fastened to the wood blocks *H*. The dry cells are connected in series. The ruby glass *D* fits in a recess in the top of the board of the box *A* and should be glued to that board.

With reasonable care the batteries will last at least a year and the amateur photographer will find that the negatives are far better developed in this manner. Roll films can be developed in the same manner as plates by attaching them to a glass plate of the same size as the film, using rubber bands to hold it closely to the plate surface.—V. A. OLDROYD.

A Sanitary Home-Made Tooth-Brush Holder

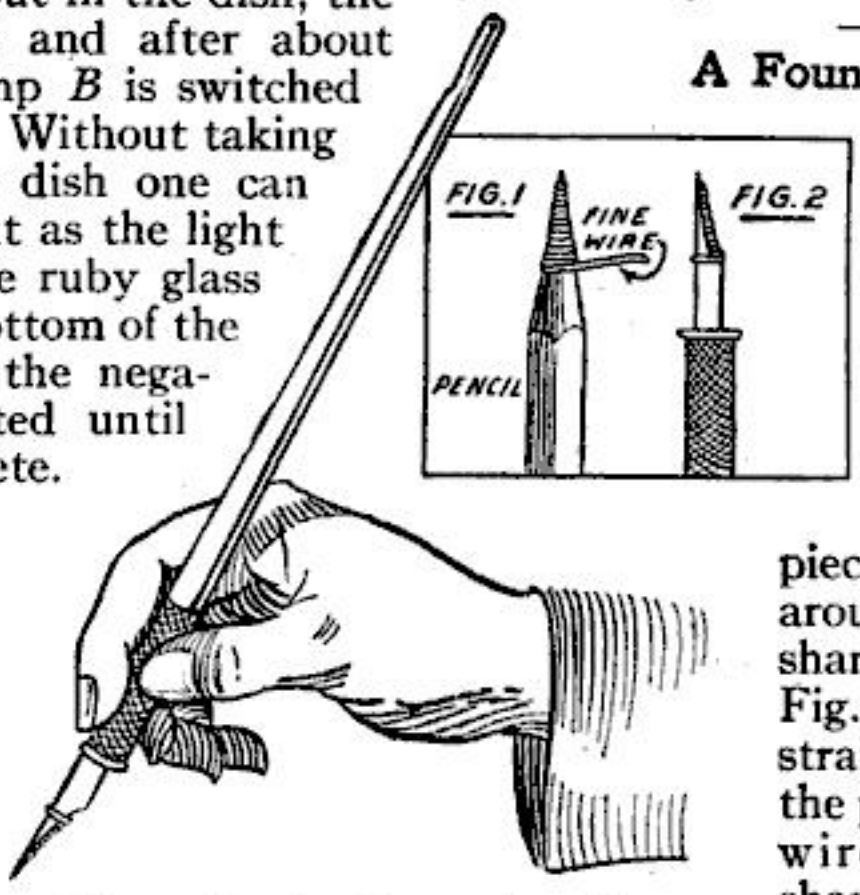
PROCURE a small bottle and fasten to its lower part a wire hook with an electric or rubber band. The hook is used for hanging the bottle to the wall in a convenient place. The tooth-brush is forced through the neck, which holds it until needed for use. The bottle is hung in an inverted position.—JAMES E. NOBLE.

The toothbrush is forced through the neck of the bottle

A Fountain Attachment for Ordinary Pens

AN ordinary pen can be made into a fountain pen quite easily by attaching a small fountain made of wire.

To make this fountain wrap a piece of fine iron wire around the point of a sharp pencil as shown in Fig. 1, leaving about ¼ in. straight. To fasten it to the pen, wrap the straight wire around the pen-shank. The coil part is fitted into the underside or hollow part of the pen with the pointed end down, as in Fig. 2. The coiled part forms a pocket for holding the ink which is fed to the pen between the coils. The dipping of the pen in the ink fills the coil. This fountain will hold a good quantity of ink.

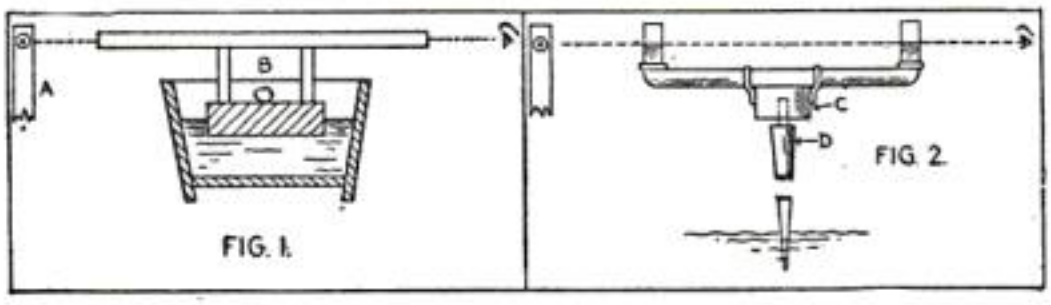


The coil of wire makes the fountain for an ordinary pen

Substitutes for the Ordinary Carpenter's Levels

IN laying the foundations of a house a rubber hose may be used as a substitute for a carpenter's or engineer's level. The illustration explains how to use it. It is evident that the water will be at the same level in both ends of the hose.

Another way is to set a tub almost full of water at about the proper height, near the center of the building. A block of wood supporting a long rule, as shown in Fig. 1, is placed on the water. As the block can turn around freely, the leveling can be obtained in all directions. To adjust the rule, direct it to a point *A* at some distance, turn the block end for end, and if the rule points exactly towards *A* again, it is properly placed. By moving a small stone *B* back and forth on the block, the proper adjustment can be easily obtained.



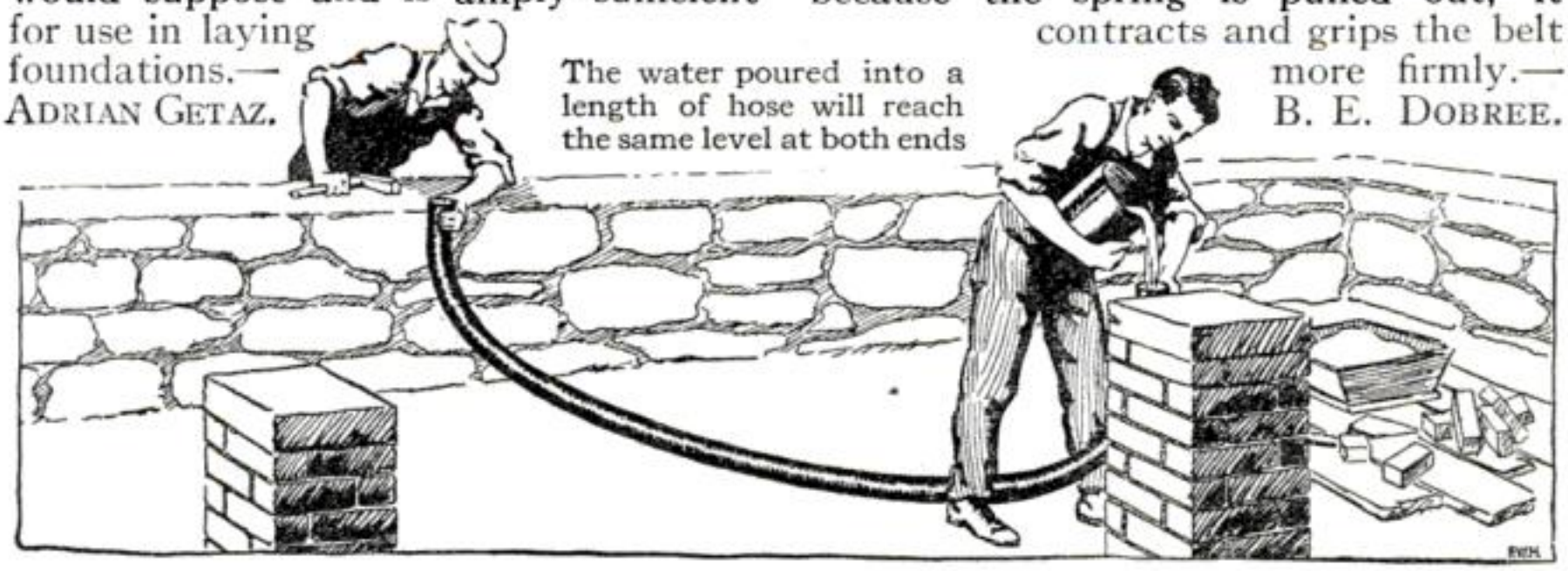
Two methods of constructing an accurate level, using water as a medium to obtain the straight-edge or sighting level for a distant mark

The best method is to make the water-level as shown in Fig. 2. This level can be made by anyone handy with tools. It is composed of a block *C* that can revolve on the end of the staff *D*. To the block is attached a tube 3 or 4 ft. long, terminating at both ends with glass tubes—lamp chimneys will do. Water is poured in until it reaches about half way up the tube. No adjustment is needed since the water is at the same level in both tubes. The instrument is far more accurate than one would suppose and is amply sufficient for use in laying foundations.—ADRIAN GETAZ.

A Good Substitute for a Solid Round Belt

WHEN a round belt of the kind used on a jig-saw machine, or light lathe, is required and a solid round belt cannot be obtained, a very good substitute, superior in some ways to the solid belt, can be made by using a rawhide belt lace somewhat longer than needed. After soaking it in warm water for some time to soften the leather, proceed to twist it up until it is perfectly round. Then hang it up to dry with a weight of 30 pounds or more on the end. This will make a belt with a better grip than that of the solid belt, and it has the added advantage of being adjustable. By undoing the ends and either twisting or untwisting it, the length can be increased or curtailed considerably. The twisted leather belt will also have a better grip on the grooves of pulleys than the smooth-surface round kind.

For fastening the ends, make a close spiral spring about 2½ ins. long and of such a diameter that the round belt will fit in tightly. When the two ends of the belt meet in the center of the coiled spring the ends of the wire are passed through the leather in the form of a hook. This makes an ideal joint which has flexibility and is easily removed for tightening. It will not tear out like the usual hooks on account of the holes being so far away from the ends. Also because the spring is pulled out, it contracts and grips the belt more firmly.—B. E. DOBREE.



The water poured into a length of hose will reach the same level at both ends

To Prevent Steel from Rusting After Soldering

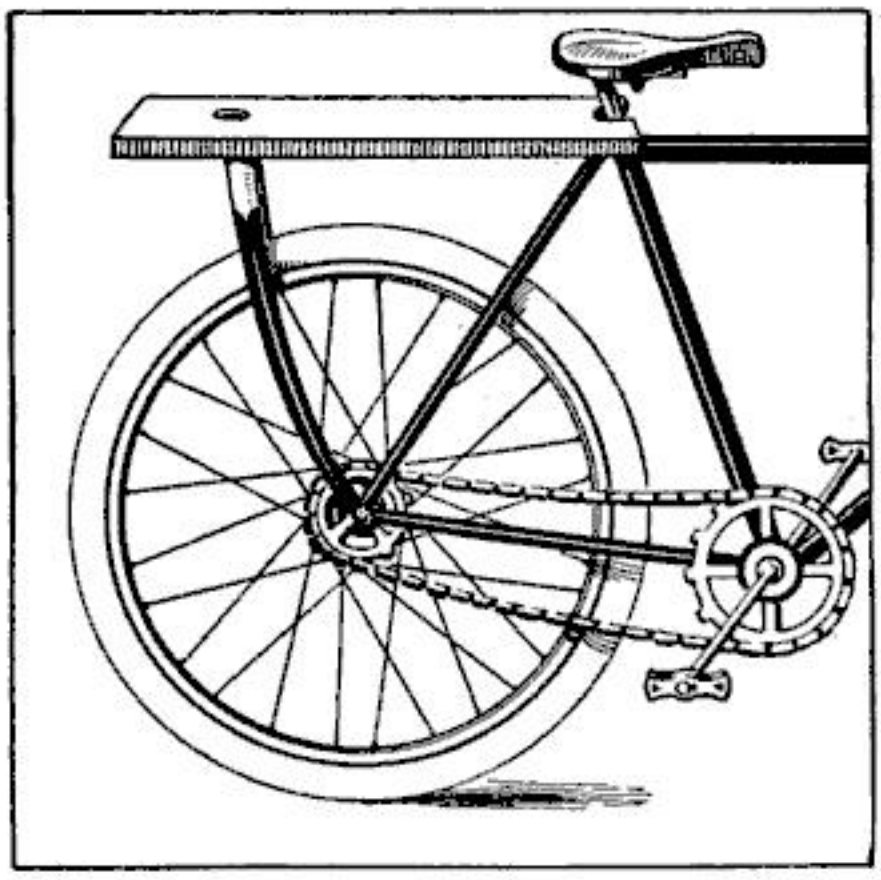
SOLDERING acid will cause steel surfaces to rust rapidly after the job is finished if not thoroughly cleaned off. If there is much of this work to be done it is well to have a bottle on hand filled with a solution of ordinary washing soda. When through soldering apply the soda water and wipe dry. A block can be made to hold both the acid and the soda water bottles where they will be convenient for the work.

Luggage-Carrier to Attach to Your Bicycle

THE front fork of an old bicycle frame and a rectangular board will make a practical luggage-carrier for a bicycle.

Cut off the steering tube about 1 in. above the crown of the fork. Remove the outside nuts which secure the rear axle, slip the holes in the jaw-end of the fork over the axle-ends and replace the nuts.

Bore a hole in the board so as to permit the sawed-off steering post to enter it. Cut slots in the other end to permit the board to fit around the seat-post. A strap will hold the board-end securely to the seat-post. Make it of metal and

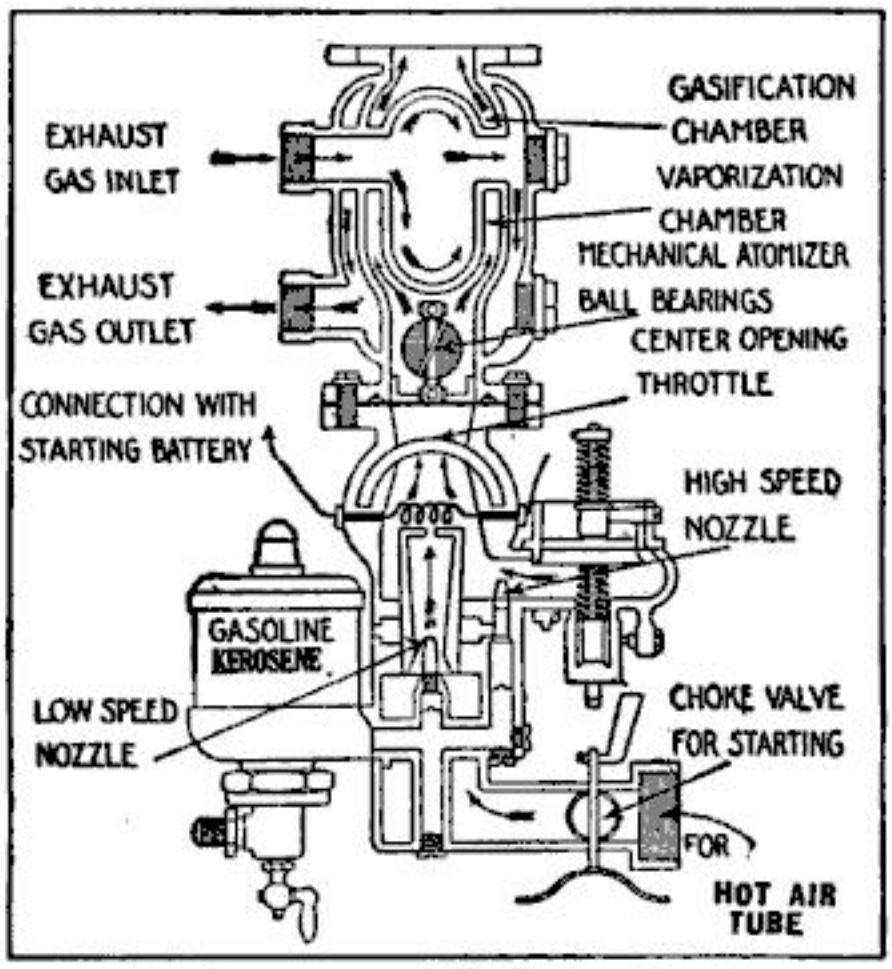


A board and the front fork of a bicycle make an excellent luggage-carrier

fasten with screws to the end of the board. Dimensions can be made to suit individual cases.—SEYMOUR CLARK.

Automobile Carbureter for Heavy Fuel Oils

THE automobile carbureter illustrated is designed for use with low grade or high grade gasoline, naptha or kerosene, or a mixture of these. It



A carbureter specially designed so that low or high grade fuel oils may be used

differs from other types in that the passage of an electric current through a coil of wire connected with the storage battery of the car's ignition, lighting or self-starting system is placed below the throttle to heat the mixture enough to give instant ignition when starting. This is necessary because low grade fuels, such as kerosene, will not vaporize sufficiently when cold to form an explosive mixture. In most other carbureters using heavy fuels, the motors are started on gasoline and then switched over to the heavy fuel.

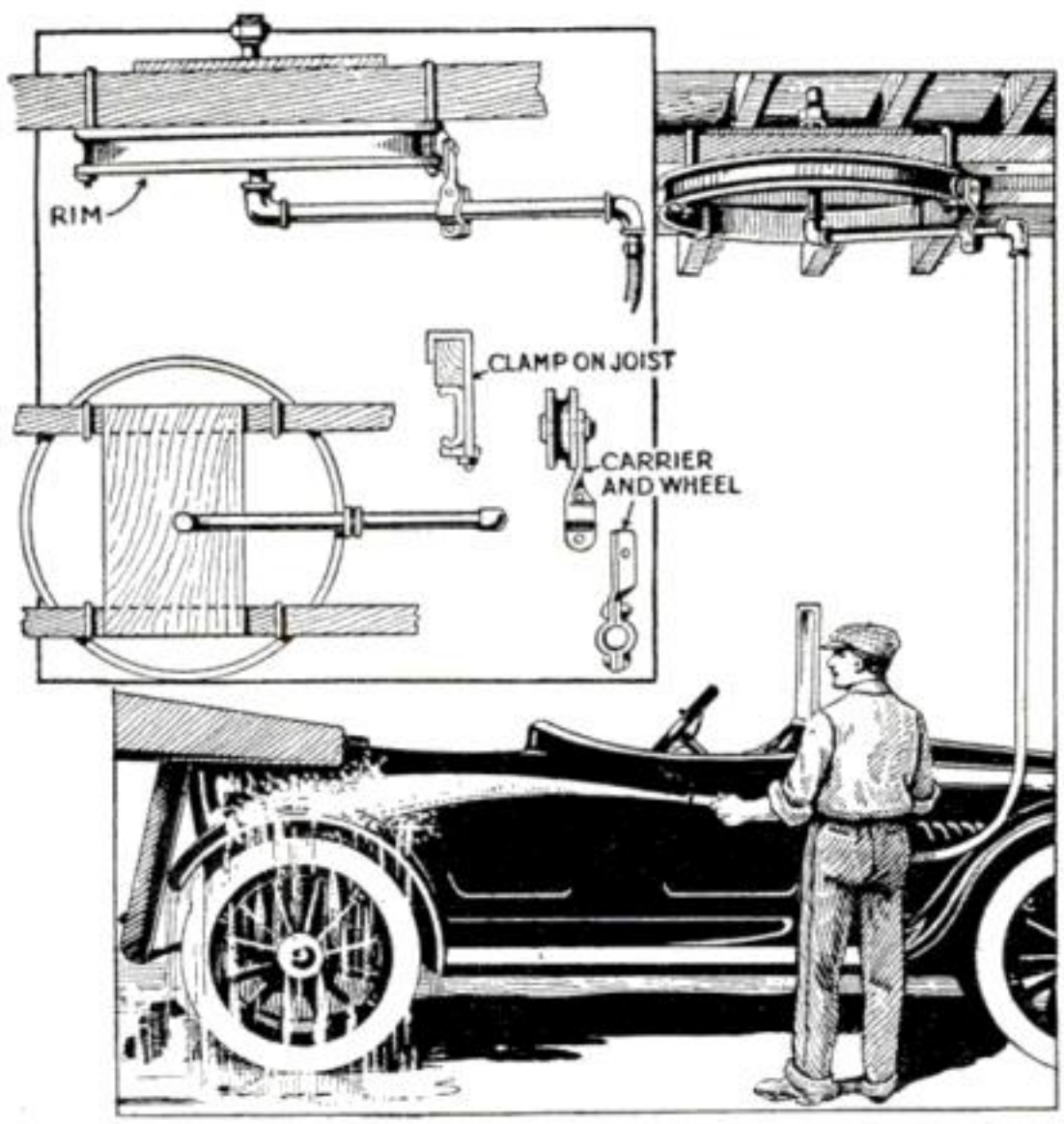
The coil only serves to start the motor, after which the current is turned off. After the motor is started the fuel is kept heated by passing the exhaust gases through a chamber surrounding the top of the carbureter between the throttle and the point of attachment, to the intake cylinder of the manifold.

A NAIL may be more easily drawn if it is first struck a blow with the hammer. This starts the rust.

An Automobile Revolving Washer Made from an Old Rim

THE accompanying illustration shows an automobile or carriage-wash-stand fixture the base of which is an old clincher-rim. This was made by a garageman in spare time and does the work as well as any fixture of this kind that can be obtained on the market. Much better results are secured and time saved if the hose is attached to an overhead revolving fixture, as it enables the operator to walk around the car without dragging the hose or "kinking" it.

Two pieces of 2-in. by 4-in. stringers are attached to the ceiling beams, these being spaced by a 12-in. by ⅞-in. board which acts to steady the water-pipe passing through it and leading to the source of supply. A swinging union coupling, or elbow, is needed to join the rotating and non-rotating parts of the water-pipe, which may be constructed of either ¾-in. or 1-in. standard-iron form.



The rim furnishes an excellent track for a pulley to carry the pipe in a circular sweep on the ceiling

The rim is firmly secured to the stringers by clamps bent from ⅜-in. cold rolled rod as indicated in the drawing. The pipe is supported by a simple trolley-wheel fixture clamped to the pipe, the wheel being grooved so it will be guided by the curved flange of the clincher-rim. This makes it possible to swing the pipe to which the hose is attached around so that all parts of the body or running gear may be easily reached, and it keeps the hose from rubbing on the floor.—V. W. PAGE.

How to Make a New Bureau From an Old One

THIS was the method used to change the entire appearance of an old bureau. The mirror was taken off the back posts and put out of harm's way. The brass-plated fixtures were removed and scraped. All useless ornaments were taken off. Then the varnish was removed with the aid of a common square scraper, some carborundum paper and some steel wool. A curb about 3 in. high was put at the rear edges of the top, to prevent small articles from falling down between the bureau and the wall.

Four coats of white lead and oil, with a dash of turpentine and Japan drier were given, 48 hours apart. After the fourth coat the job stood for three days to harden. The surface was then worked over with steel wool until all brush marks and roughness had disappeared. Then two coats of ivory white enamel were applied, 48 hours apart. With this done the bureau looked like unglazed porcelain. China knobs were used for the drawer pulls. The drawers had previously been examined and the slides rubbed with white castile soap so that they worked smoothly.

A Quickly Made Silver-Plating Powder

A good silver-plating powder can be made of chloride of silver, 3 oz.; salts of tartar, 6 oz.; prepared chalk, 2 oz.; common salt, 3 oz. Mix well.

Replacing a Knob on an Aluminum Kettle Top

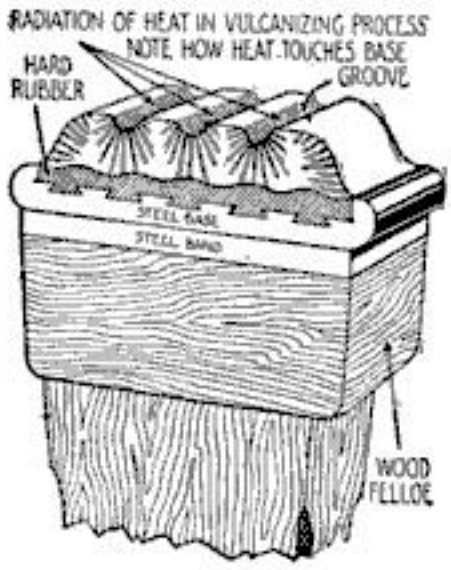
IF the knob is broken from an aluminum kettle cover, a large ragged hole is left which will render the kettle practically useless. If the edges are filed smooth

Two washers and a stove bolt used to repair the broken cover of a kettle

and two tin roofing-caps are used as washers, one on the underside and the other on the outside of the cover, and the knob fastened with a small stove bolt, as shown in the illustration, the kettle will be as good as new.

Grooves Necessary in Giant Motor-Truck Tires

FOR several years solid rubber tires for motor-trucks were never made wider than 7 in., and where necessary to have them wider, a twin or dual tire was used on each wheel. Tires of greater width than 7 in. gave poor results as the tread would separate from the base. Tests have proven that this separation was caused by insufficient vulcanizing of the rubber near the base. Increase in the width called for an increased thickness of the area and this would not vulcanize uniformly. If the rubber near the base of the tire was properly vulcanized it usually happened that near the tread would be overcured and brittle, while if the latter was properly vulcanized the portion near the base would be soft and putty-like.

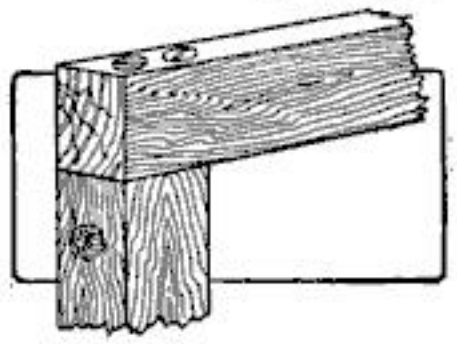


Three grooves to cure tires properly

A great deal of experimenting solved the problem by forming three deep grooves in the tread surface. These grooves permit the heat for vulcanizing to reach all portions of the tire area.

Making Screws Hold in the End Grain of Wood

THE very nature of the grain running lengthwise makes it exceedingly hard to fasten the threads of a wood screw so that it will hold for any length of time. Where it is necessary to fasten the joints of wood in the fashion shown in the illustration, one of the best methods is to insert a wood pin in a hole bored crosswise with the grain. The size of the pin will depend on the joint and on where it is used. In fitting the pin to the hole make it large enough to drive in snugly. A little glue applied to the surface will fasten it in place.



A wood pin in a hole bored across the grain

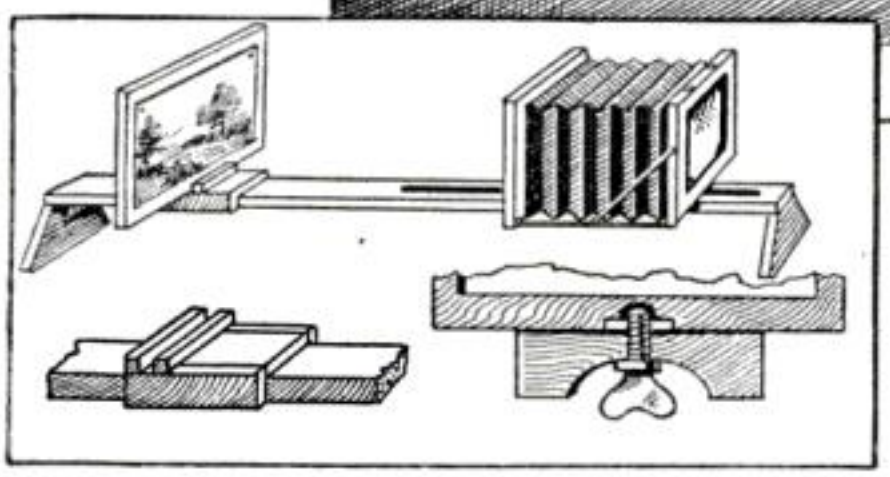
Adjusting a Storm Sash from the Inside of a House

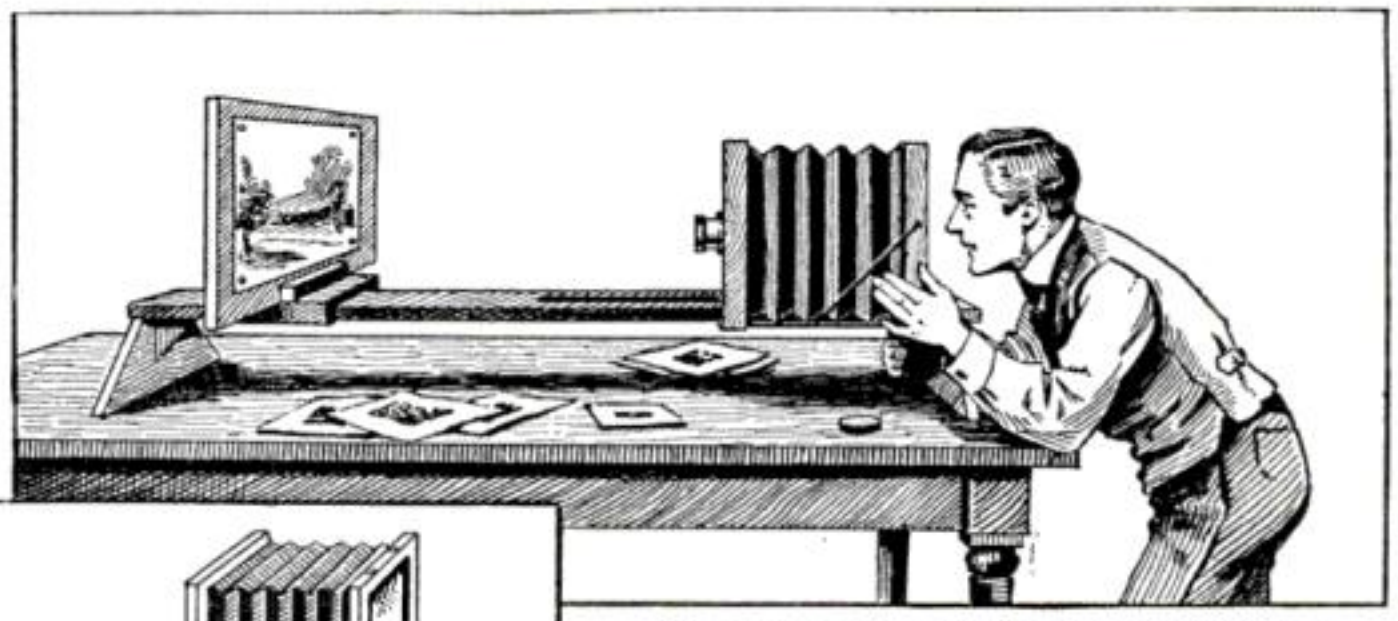
BY applying the following method, a storm sash may be adjusted from the inside of a house. Two pins are driven into the top rail of the sash and holes provided in the window casing at the top to receive them. The pins may be made either of 3-in. nails with their heads removed or short lengths of dowels. The location of these pins is shown at *A*. To install the window, push it through the opening left by raising the lower sash, set the pins in the holes and pull the bottom in place. The lower part is held with two small hooks as shown at *B*. Storm sash provided with holdings of this kind require no ladders to put them in place on upper windows.

Storm sash applied from the inside

A Home-Made Photographic Copying-Stand

TO PREPARE the camera and board so that copying may be done properly is a difficult task for the amateur, as the surface of the picture to be reproduced must be in a vertical plane and exactly parallel to the camera lens. The lighting of the picture must be considered and the task of adjusting all parts to meet the conditions grows harder as each successive step is taken in copying. A stand is most desired, but the arrangement shown in the sketch will suffice and it can be used on the work table. It is made of a board for the base, 4 ft. long and 5 in. wide, mounted on supports that are 2 in. wide, one at each end, cut as shown. These supports are strengthened with a bracket fastened on the underside of the baseboard. It is best to use wood screws for holding the parts together, glueing the joints before putting in the screws. A slot is cut in the center of the baseboard at one end, which extends about halfway to admit the thumb-screw used to fasten the camera to the tripod. If the baseboard is cut from material more than ¾ in. thick it may be necessary to cut the wood out from the underside so that the thumb-screw will enter the camera socket. This cut-out recess is shown in the cross-section.





Camera and easel base made with low supports so that it sets on a table

The copying-board is made detachable from the sliding-holder, as well as the holder from the base. The size of the holder will depend largely on the board it is to hold and the closeness of the fit. It takes the shape of a box with both ends and one side removed, or it can be used with both sides. Two strips are fastened on the upper side so that a space is formed between them to admit the edge of the board to prevent it from tipping backward and forward.

Both camera and sliding-holder are easily adjusted and the whole stand may be moved about to get the best results for lighting. The finish of the base should be without paint or varnish—just a smooth, planed board so that the camera and holder will slide easily.

The board may be removed and the holder used to support a vase or other similar article which it may be necessary to photograph. It is well to have the holder long enough to provide a place in front of the board upon which to set these objects; then a sheet of plain or tinted paper can be attached to the bottom and curved to form a suitable background with a continuous foreground.

A Snow Shovel That Prevents the Snow from Sticking

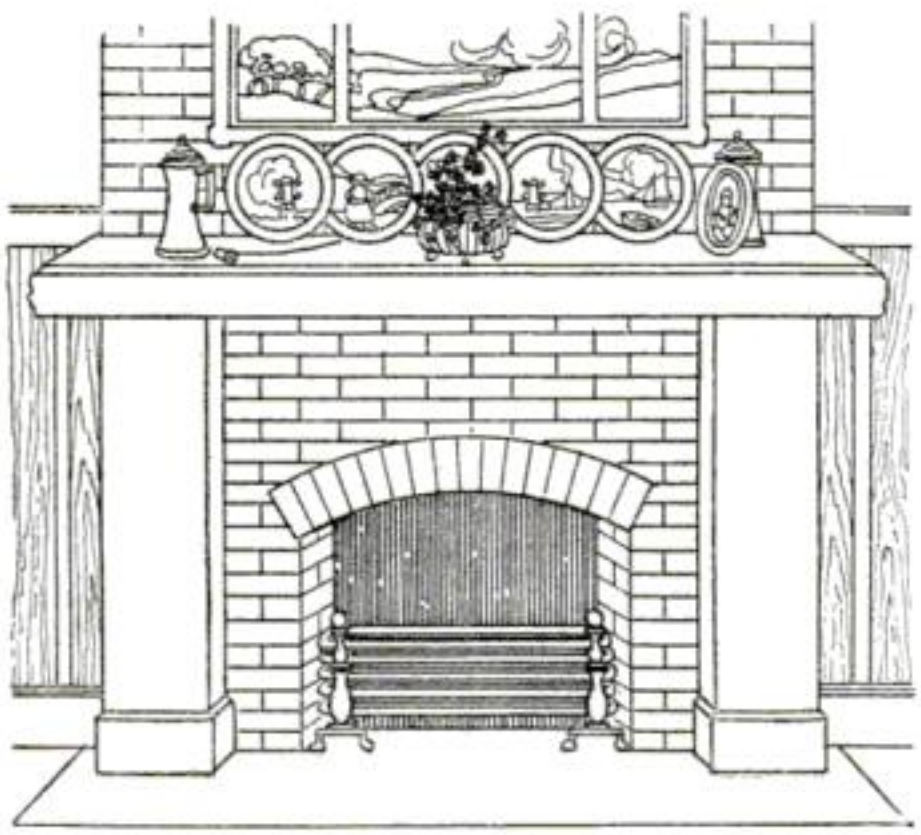
VARIOUS kinds of shovels have been tried and I have greased them to keep the snow from sticking to the surface, but at no time have I ever had so much satisfaction shoveling snow as when using the regular potato or manure fork. Such a fork will take up as much snow at a time as a scoop shovel, while, no matter how wet the snow, it never carries any superfluous weight of snow back and forth.—PAUL R. STRAIN.

A Makeshift Syphon Fashioned from Paper Tubes and a Thread Spool

THE following plan proved very successful for drawing wine from a jar without disturbing the sediments, at a time when a syphon was not available. A ¼-in. hole was bored in the side of a common spool on a 45 deg. angle with the hole already running through the spool. I then rolled a couple of sheets of clean paper into tubes and inserted one into the hole just bored and the other into the other hole, making the syphon in the form of an inverted V. The hole in the top of spool was tightly corked and my makeshift syphon was ready for business. That it proved satisfactory goes without saying. Such a syphon can be utilized in photography for removing the clear fluid from mixed chemicals.—EDWIN R. MASON.

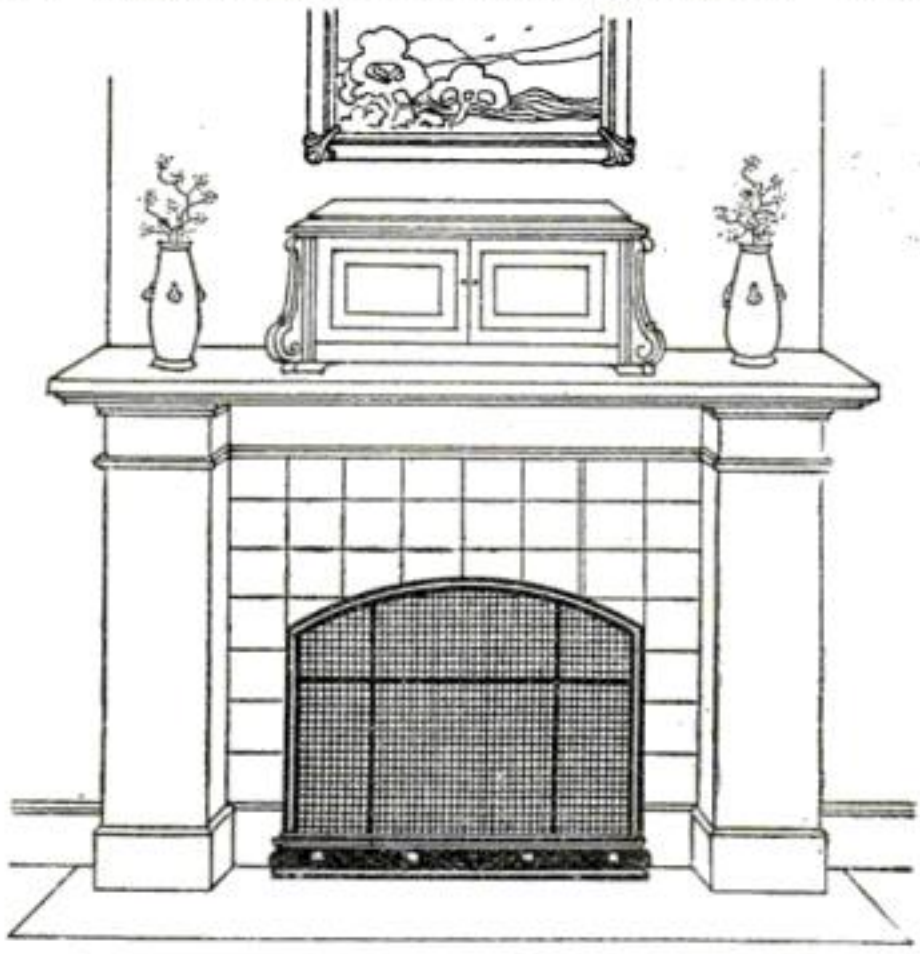
Utilizing the Waste Heat from an Open Fireplace

ALMOST all the heat produced in a fireplace located in a wall between the living-room and the dining-room of a certain house was used for heating the water for the bath and to heat the dining-room in the following manner: A coil of pipe was put in the opening just back of the flames



A coil of pipe is run in the fireplace to heat the water in the range boiler

and connected to a range-boiler. Pipes were run from the boiler to the bath and sink. Instead of a solid brick back to the fireplace a thin wall of metal was inserted in the dining-room side. A false mantel with open grill-work covered the metal wall. Above the grill-work and on the mantel was placed a fireless cooker, built into the chimney-breast directly against the brick and lined with asbestos. The



On the opposite side and in the dining-room is a false fireplace with a thin backwall

exterior finish of the cooker was made ornamental so that it did not look at all like a cooking utensil.—MRS. H. COLDWATER.

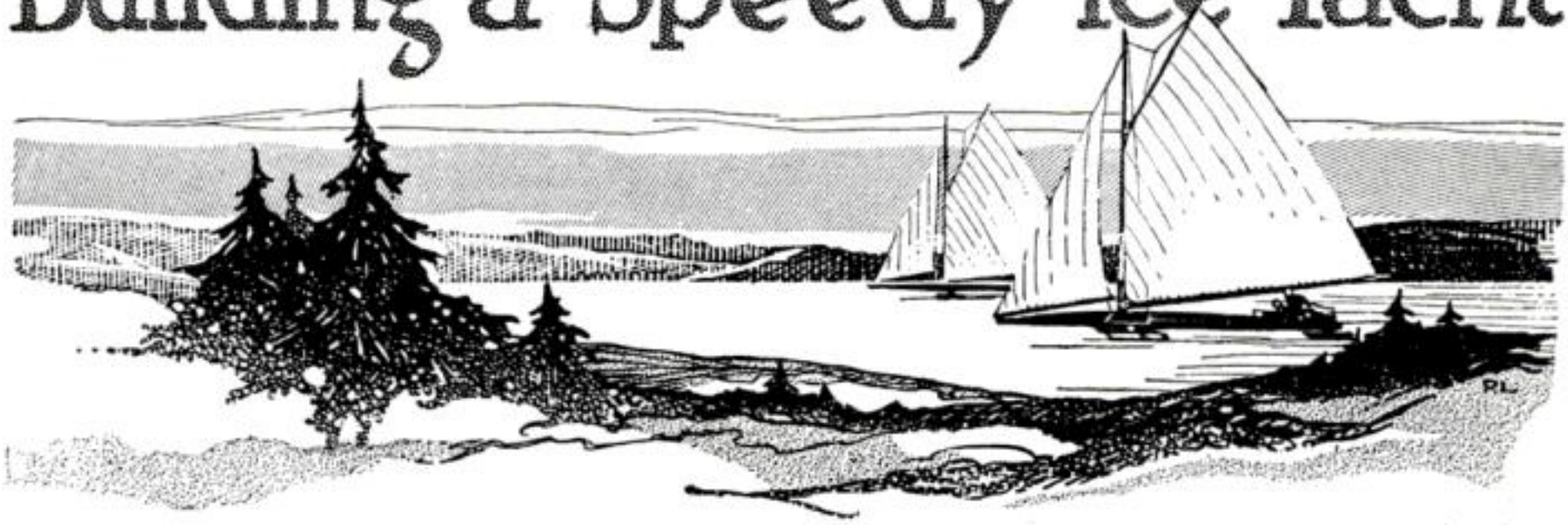
Eliminating Trouble with Toilet Flush-Tanks

MUCH trouble is experienced with toilet flush-tanks where the chain pull is installed. When the bowl is flushed the chain is nearly always pulled down and outwards instead of straight down, as it should be pulled. When the chain is pulled outward it will eventually throw the inner working parts out of line, thereby preventing the valve from closing tightly. A good way to avoid this is to turn a screw-eye into the bottom edge of the flush-box directly under the arm to which the chain is fastened, running the chain through this screw-eye. This prevents the chain from being pulled outward when flushing the bowl.

Aluminum Alloy for Patterns and Core Boxes

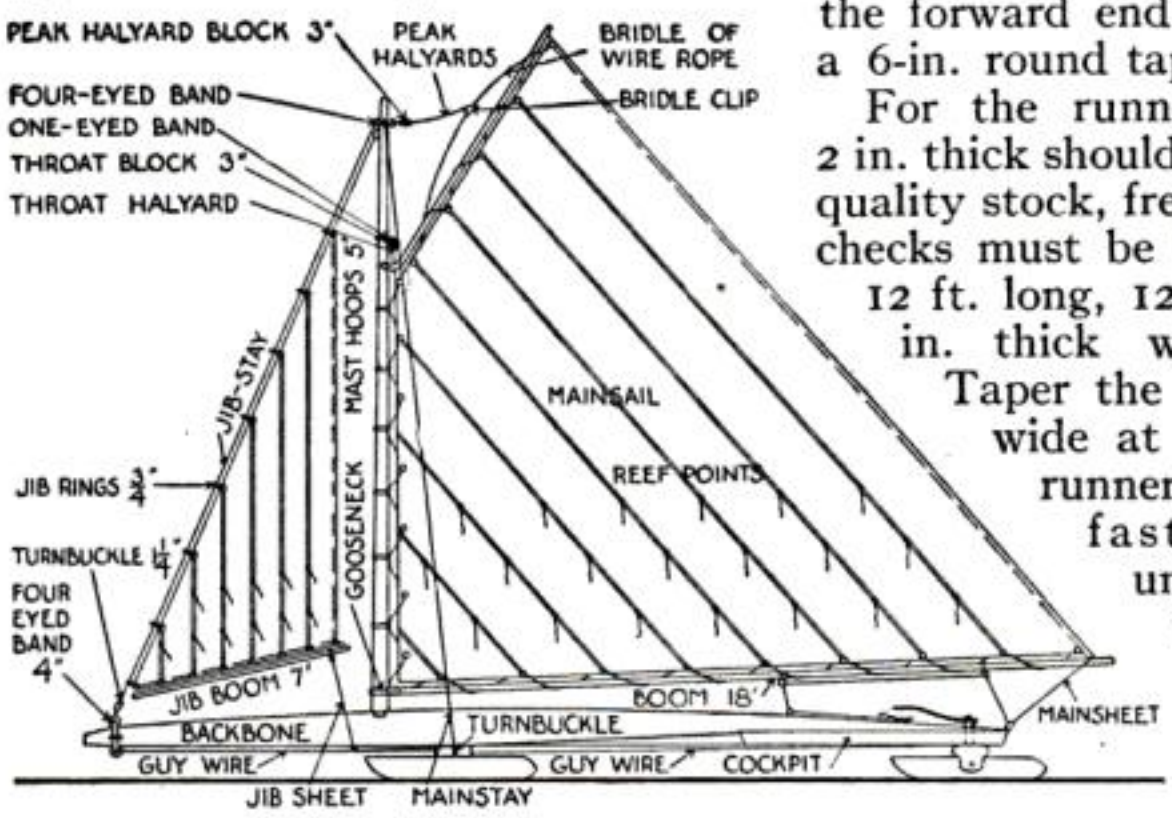
A MIXTURE of 130 parts aluminum, 25 parts zinc and 10 parts ferro-zinc is an excellent alloy from which to make patterns and core boxes. It also makes a casting that is strong and light and at the same time inexpensive. It is easily mixed in the crucible and the resultant metal has a very attractive smooth finish.

Building a Speedy Ice-Yacht



ANY one who is at all handy with tools and has the ability to build any kind of a boat, will find it easy to construct a first-class ice-yacht from the sketches and scale drawings given. This particular type of craft is a splendid all-round model and is known among ice-boat men as a "wire-boat," because the wire guys run from end to end. This form of construction makes a very rigid and strong boat, capable of standing up in the heaviest weather, yet showing plenty of speed in light winds. The construction is clearly shown in the illustration.

The details for making the backbone or keel are given in the drawing. It is necessary that only the very best quality of lumber should be used, clear white pine being the first choice. Spruce however, makes a very good substitute, and white cedar is also used to some extent, but it must be the clear white cedar of the North; southern cedar is less durable for this purpose. The backbone is 25 ft. long, 10 in. wide in the widest part and 4 in. thick throughout. The stern-end of the timber is cut on a bevel as shown, while the forward end is finished with a 6-in. round taper.



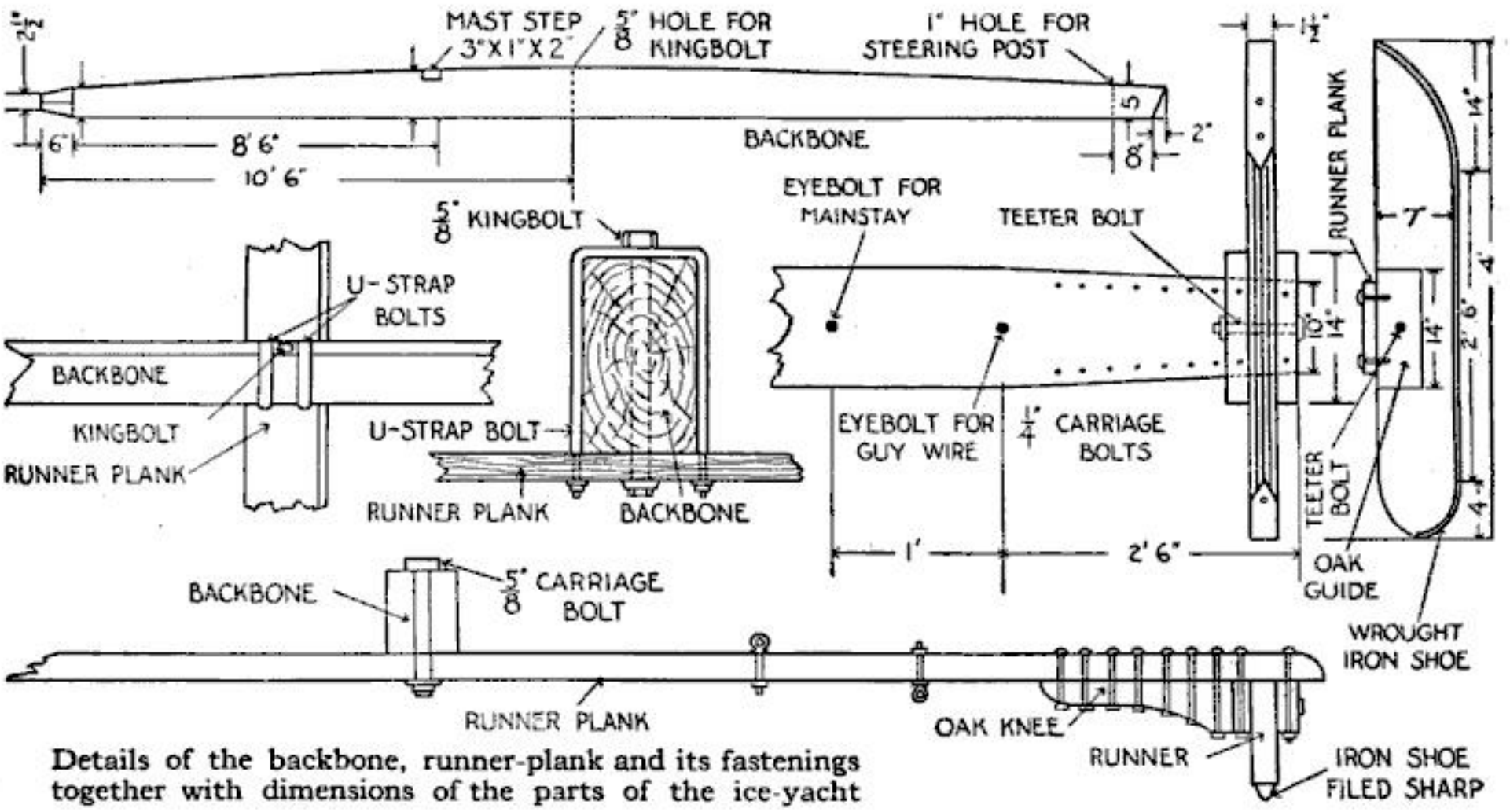
Elevation and plan of the ice-yacht with dimensions and parts named showing their relation to one another

For the runner-plank, spruce 2 in. thick should be used. First quality stock, free from knots or checks must be used. A plank 12 ft. long, 12 in. wide and 2 in. thick will be needed. Taper the plank to 10 in. wide at the ends. The runner-plank is solidly fastened to the underside of the backbone with a 5/8-in. carriage-bolt in the center and two U-shaped strap-bolts on each side.

In bolting the runner to the backbone it is very important to fasten it at absolutely right angles. Any departure from the perfect angle, however slight it may be, is sure to injure the sailing qualities of the boat. To insure accuracy, it is a good plan to clamp the two pieces together in the correct position with two or three heavy

clamps, before boring the holes for the bolts. The U-strap bolts will need to be made by a local wheelwright or blacksmith, who will no doubt loan the clamps.

Full details of the runner-plank construction are shown in the drawing. The outside runner-guide is bolted to the underside of the runner-plank 1 in. from the outside edge. Two pairs of guides will be required and they should be made from straight-grained oak, 14 in. long, 4 in. wide and 1½ in. thick. From the inside of the first guide measure off 1¾ in. and bolt the second or inner guide across the plank parallel with the first one. This will leave a slot 1¾ in. in width between the guides



Details of the backbone, runner-plank and its fastenings together with dimensions of the parts of the ice-yacht

in which to insert the runners later. Carriage bolts ¼ in. in diameter are used for fastening the guides in place. To further strengthen the head of the plank, an oak knee is butted against the inner guide and bolted to the plank as shown. Make the knees about 18 in. long and the same width and thickness as the oak guides. When bolting the guides in place, take particular care to have them absolutely at right angles to the plank, otherwise the boat will "track" poorly, and prove slow. In order to get this right, clamp the pieces in place before boring the bolt-holes. After all the nuts are set up on the bolts, peen over the edges of the bolt-ends so that the nuts will not be lost should they happen to loosen up at any time.

The side runners are sawed from straight-grained white oak, 1½ in. thick, 4 ft. long, 7 in. wide and shaped as shown. The runners are shod with wrought-iron shoes made of 1-in. iron, and solidly attached to the oak runners by long flat-head screws, which are countersunk. Round iron is generally used for the shoes, and that the iron may be rigidly clamped in place, a slot or groove is cut in the bottoms of the runners to receive it. However, half-round iron may be used, if desired. That the shoes may "bite" the ice well, the running surface is filed to a V-shape as illustrated. When doing this work, considerable care must be taken to make the filed edge perfectly straight, for any waviness is certain to cause the craft to slide and deviate from its course.

The completed runners are inserted between the oak guides and "hung" to the runner-plank by means of a ½-in. teeter-bolt. The usual practice is to hang them in the center of the runner surface as shown, leaving a space of about ¾ in. between the top of the runner and the runner-plank. In boring the hole for the teeter-bolt, make it a comfortably snug fit, so that the runner will move on the bolt as upon a pivot.

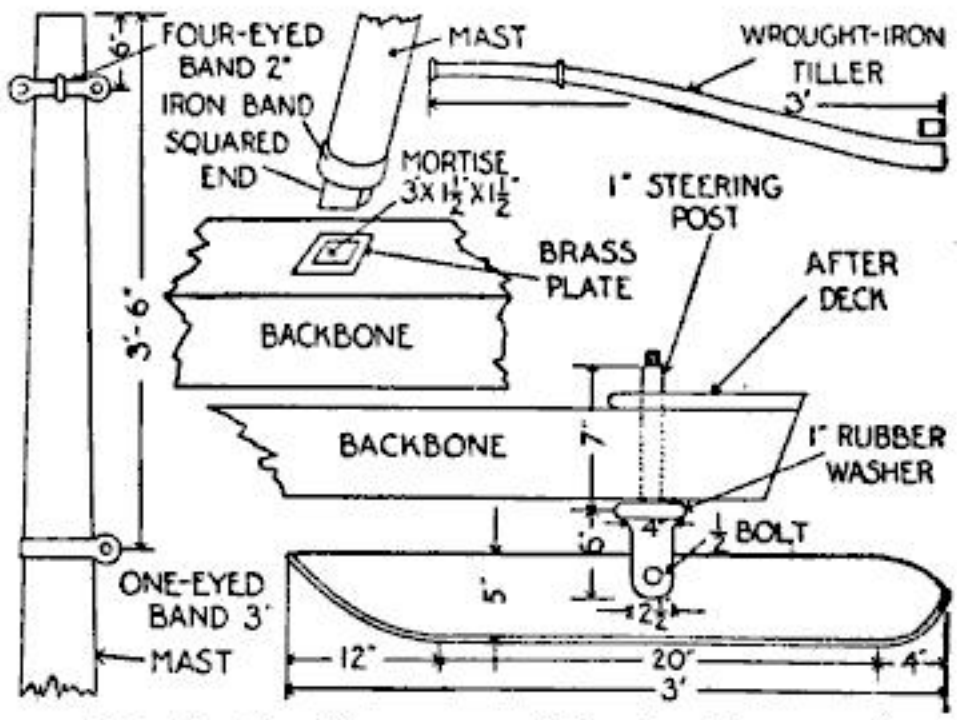
The rudder, or steering runner, is made of 1½-in. white oak, 3 ft. long and 5 in. wide. It is shod with wrought-iron the same as the side runners. Complete details are given in the drawing. The rudder-fitting and tiller can be made by any ironworker or local smithy. To afford a good grip for the hand, the end of the tiller may be

wound with a generous length of fish line.

Details of the cockpit are given but this may be made of any size, although the 7-ft. cockpit shown will prove very satisfactory. The flooring is made by fastening spruce boards to the underside of the backbone with ⅜ by 2½-in. lag-screws. Around the outside of the flooring, a ⅝-in. combing is screwed. This combing should be 4 in. wide and may be put on in straight pieces by merely mitering the joint as shown, carrying the forward pieces to form a V-shape. Butt-blocks screwed on the inside of the combing at the miter-joint and where the combing butts against the side of the backbone, will make a neat and strong fastening. However, cockpits are made in various shapes, sometimes almost oval and again with rounded corners. If this is desired, the oak board must be thoroughly steamed and clamped in place while hot and moist, otherwise it will be sure to splinter while it is being bent.

As shown in the drawing, two pairs of guy-wires are used to support the runner-plank and keep it at right angles to the backbone. Wire rope ¼ in. in diameter is used. For the forward guys two lengths of wire rope 12 ft. long are required, and two lengths 13 ft. long for the rear guys. In order to set the guys up taut and keep them so a ¼-in. turnbuckle is used at the end of each guy where it is secured to the eyebolt in the runner-plank. On the taper of the fore end of the backbone is wedged a 4-eyed band 4 in. in diameter. In the two side eyes fasten one end of the two fore guy-wires. This may be done by making a single hitch knot through the eye and seizing the end to the standing part of the rope with marlin or other strong twine. Another way is to clamp the ends with a metal clip sold at hardware stores as a "wire rope clip." To the other ends of the fore guy-wires, fasten the eye of the turnbuckles and hook the latter into the eyebolt in the runner-plank. A heavy screw-eye is turned in through the flooring into the backbone 3 ft. from its rear end, and into this the ends of the rear guy-wires are fastened. The other ends of the rear guy-wires are lashed into the eyes of turnbuckles, and the latter hooked into the eyebolt in the runner-plank, in the same way as the fore guy-wires. By screwing up the turnbuckles, a strong and flexible stay is provided for the frame.

It is the usual practice among ice-boat builders, to use a second guy-wire to stay the forward part of the backbone. For this an 11-ft. length of ¼-in. wire rope is required. Fasten one end in the lower eye of the band on the fore end of backbone



Details of rudder-runner, tiller, backbone and mast connections and of the mast fittings

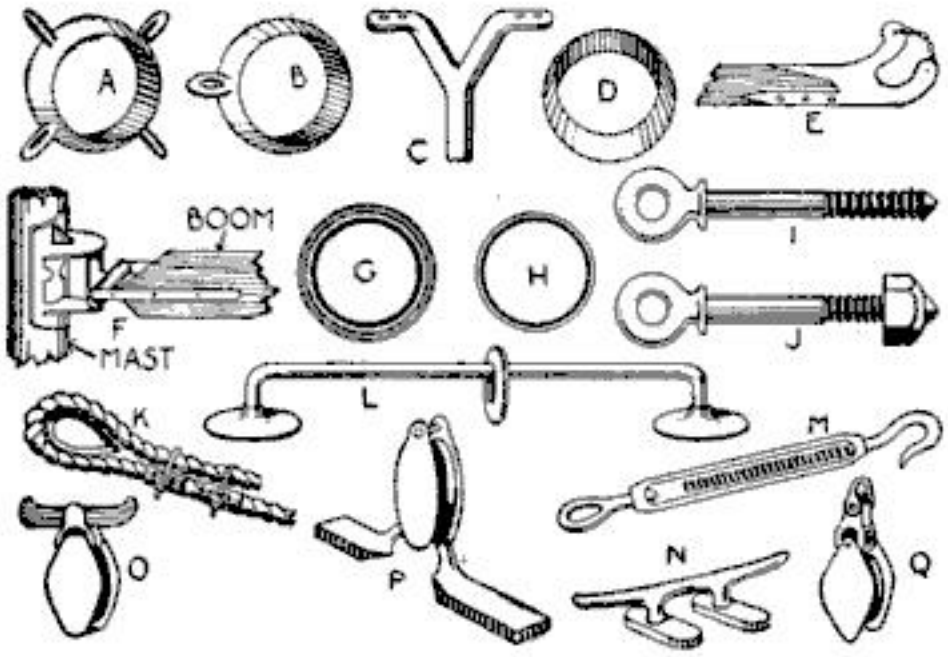
and run it to a screweye turned in the center of the runner-plank and up into the backbone. Connect the end to a turnbuckle and set this guy up taut. To keep the wire from the backbone, a V-shaped spreader is employed, as shown in Fig 1. This is quickly made from strap-iron by a blacksmith, the length of 6 in. being about right. This spreader is shown in the drawing of the fittings.

The mast is 15½ ft. long, 4½ in. in diameter at the base or foot, and tapered up to 3 in. in diameter where the single-eyed band is wedged on for the throat-halyard block, 3½ ft. from the top. The remainder of the mast is tapered to 2 in. to the end. Hickory cannot be excelled for mast and spars, and the wood is not difficult to round into shape with a sharp plane. The easiest way to do this is to first plane the mast to the desired taper in the square, then plane off the four corners to make it six-sided. Reduce the six corners to make it nine-sided. By planing off again the stick is almost round, and may be scraped smooth with a steel cabinet scraper.

The boom is 18 ft. long, 3½ in. in diameter in the center, and tapered to 2¼ in. at the mast end and 2 in. at the other end. The gaff is 8 ft. long, 2½ in. in diameter in the center, and tapered to 1⅞ in. at the mast end, and 1½ in. at the other end. The jib-boom is 7 ft. long, 1⅞ in. in the center and tapered to 1¼ in. at each end. The end of the gaff is squared

and a pair of oak jaws bolted or screwed to it, to keep this spar close to the mast. These jaws may be purchased with the other fittings, or sawed out of 1¼-in. oak.

For making the sails, heavy unbleached cotton duck 8 oz. in weight is the most satisfactory. The breadths of cloth are first sewed together by lapping one edge over the other for about ¾ in. with each edge stitched close. The narrow-lapped or bighted effect may be gained by folding over a hem and double-stitching the same



The small fittings required to connect the parts of the ice-yacht described

way as the regular seam. The laps must, of course, run parallel with the leach or after side of the sail, as shown in the sail plan. To make the sail strong and serviceable, it is the usual practice of sail-makers to sew ¼-in. rope (tarred bolt-rope is the best) all around the sail. For hand sewing on canvas, a diamond-pointed sail needle and a sailor's palm will be required to force the needle through the rope and cloth. The stitch used is simple overcasting. The seams of the sail itself may be stitched on the sewing-machine, but the hand-sewn sail is the strongest. At each corner of the sail, sew on a semicircular path to reinforce the sail at these points.

The sail is attached to the mast-hoops and gaff and boom through grommets. An easy way to make these grommet-holes is to procure about 3 doz., ¾-in. galvanized iron grommet-rings. Punch a small hole in the sail where the grommet-hole is wanted, place a ring on each side of the hole and sew the ring to the sail by means of an overcasting stitch, using waxed sail twine and a sail needle. The reef-points may be simply sewed to the sail, but the sailor's way of doing this, is to sew in ½-in. grommet-rings to reinforce the sail. The reef-points are 6-in. lengths of cotton rope. About ⅛-in. twine may be used. The sails should be cut at least 6 in. shorter than the spars so that plenty of room is left for lashing them after the sails have stretched, which they are certain to do.

The mast is stepped by squaring the foot or heel as shown. To prevent the end of the spar from splitting or checking, drive on an iron band or ferrule. To do away with wear of the mortise, cut in the backbone to receive the mast. It is a good plan to face the hole with a piece of sheet brass.

The mast-head is rigged as shown, 3½ ft. from the top. A single-eyed band with eye to the rear or on the after side of mast, is wedged on the mast-head. The 4-eyed band is wedged on the mast 6 in. from the top as shown. In the forward eye of the top band, lash the end of the ¼-in. wire rope used for the jib-stay. In the after eye, hook the 3-in. pulley-block, to be used for the peak-halyards. In the two side eyes, lash the ends of the ¼-in. wire rope used for the mainstays. In the single-eyed band, hook the 3-in. pulley-block for the throat-halyards, and in the eye in the top band, underneath the jib-stay, hook the 3-in. block for the jib-halyards.

Each end of the stay is lashed to the eye of a turnbuckle, the jib-stay being carried down to the top eye in the band on fore end of backbone, and the two side guys, or mast stays, carried down to the eyebolt in the runner-plank on each side of the mast. Before stepping the mast, slip on the six mast-hoops, and the eight jib-rings, and reeve the halyards through the blocks on the mast-head.

The rigging may now be set up taut by screwing up the turnbuckles. The gaff is kept close to the mast by its jaws. To prevent any possibility of the jaws becoming unshipped—which is a common occurrence—it is customary to bore a hole through each end of the jaws and run a wire through. That the jaws may slide up the mast easily without binding or jamming, string a few round hardwood beads on the wire after the jaws are in position around the mast. These loops are known as parrels, and the beads are made of lignum-vitae. The ½-in. size is suitable for the purpose, and six beads will suffice.

The boom is fastened to the mast by means of a fitting called a gooseneck. These fittings are of various models, a good

one being shown at *F*. The mainsail is secured to the mast-hoops through the grommet-rings, by seizing them together with a few turns of marlin (which is strong rope-yarn) or any strong twine. The boom and gaff are laced to the spars with ⅛-in. cotton cord, running the cord through the grommet-holes and around the spars. The jib is attached to its stay by seizing through the grommet-rings to the jib-rings and to the jib-boom by lacing with cord.

A good way to attach the jib-boom to the stay is to screw an eyebolt in the end of the jib-boom and connect this with the eye in turnbuckle with a heavy split ring. This will hold the foot of jib in place, and allow the jib-boom to move freely. The halyards should of course be lead aft to the cockpit where the skipper can reach them without leaving the cockpit. The best way to do this is to screw a double or two single pulley-blocks on the runner-plank 12 in. from the mast, for the peak and throat-halyards of the mainsail, and a single block of the same size on the opposite side of the runner-plank, for the jib-halyards. The halyards may now be led aft and belayed to a cleat, screwed on each side of the backbone in the forward end of the cockpit.

The rope for pulling in and letting out the mainsail—known as the mainsheet—is best rigged up as shown. An iron rod, known as a traveler, is screwed on the after deck back of the rudder-post, and a pulley-block is lashed to the ring on the traveler. The rope is fastened to the end of the boom, and is led through the block on the traveler, up to two blocks lashed to the boom and down to a block screwed to the top of backbone, which affords a splendid leverage, without putting the blocks in the way of the steersman's head when he is going about.

The rope for controlling the jib—called the jib-sheet—is lashed to the end of jib-boom, thence led to a pulley lashed to the guy-wire, and aft to the cockpit.

All the fittings required are illustrated in the drawing and may be purchased from dealers in marine hardware or yacht supplies. The galvanized iron fittings are to be preferred to the common black iron, owing to their non-rusting qualities. The U-strap bolts, the V-shaped spreader, the rudder fittings, and the shoes for the runners, can be made by any blacksmith, and will not prove expensive.

As a well-built boat of this type will last for many years of hard sailing, the craft should be painted, for the sake of appearance as well as to preserve the woodwork. Red or black paint gives a better effect than other colors, but this detail is one of personal choice. An attractive way to paint the boat is to finish the front of the backbone up to the runner-plank in spar-varnish and the rest of the boat aft in paint. The runner-plank may be painted out to the guy-wire eyebolts, and the heads of the plank and the runners finished in varnish. The rudder-runner may be varnished also. The cockpit is painted, but the oak combing will prove attractive if finished "bright"—that is, in varnish. The mast and spars should be well sandpapered and finished in two or three coats of spar-varnish. Bolt-heads and other fittings may be touched up with aluminum or bronze.

Preventing Exposed Water-Pipes from Freezing

EXPOSED water-pipes are apt to freeze in winter, causing much annoyance, which may be prevented by covering them with the following mixture: To a solution of thin boiled starch add sawdust until the mixture forms a thick paste. A fine sieve may be used to clear this sawdust from lumps.

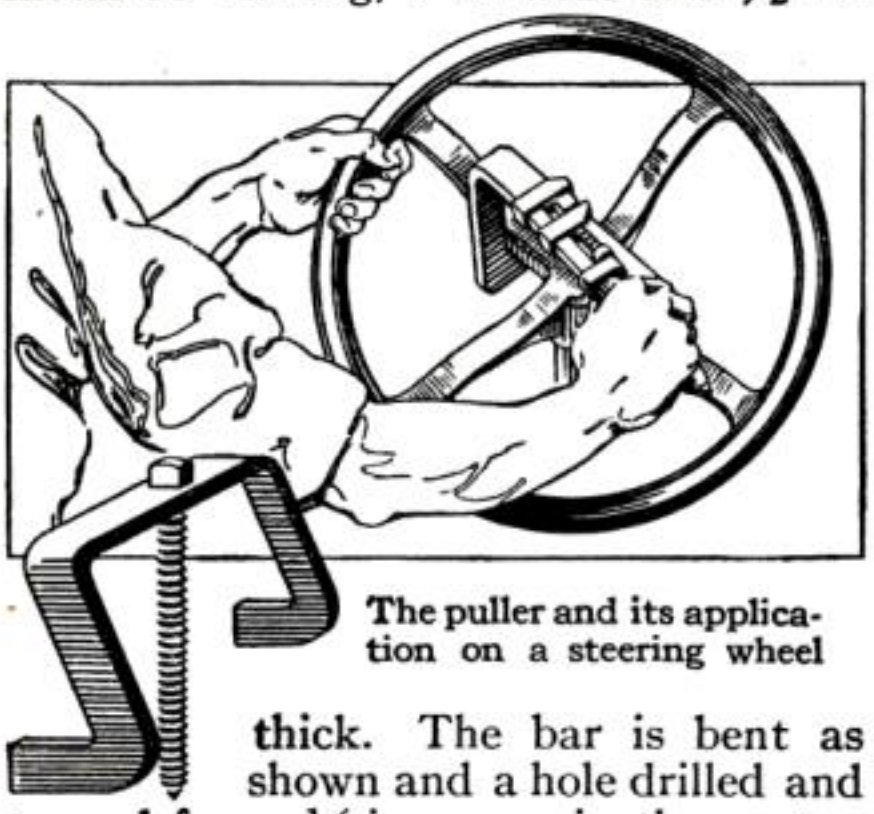
Heavy cord is first wrapped around the pipe, spacing the turns about ½ in. A ¼-in. layer of the mixture is smeared on and allowed to dry; then a second layer is put on and smoothed up. The string acts as an anchor to make the coating adhere to the pipe closely. Whitewash or paint may be used to give a finish for inside pipes; but for outside work cover the coating with hot tar. If it is desired to have a very neat covering, wrap the sawdust coating with cloth or canvas, applying it in narrow strips like a bandage, and painting the outside surface. An even coating of the sawdust is necessary when covering with cloth.—THOS. W. BENSON.

How to Handle Sulphuric Acid with Safety

DANGER is often encountered in emptying sulphuric acid from a carton into a small bottle. Procure a rubber stopper that will fit the neck of the carton. Make a hole in the stopper to receive a piece of rubber tubing. Pour the acid through this.—J. H. CASSIDY.

A Puller to Remove Steering Wheels on Automobiles

A SIMPLE device for removing a steering wheel from its post is shown in the illustration. It is made of metal 18 in. long, 1 in. wide and ½ in. thick. The bar is bent as shown and a hole drilled and tapped for a ½-in. screw in the center. The end of the screw is pointed to fit into the center of the steering head post. The two bent ends are hooked under the cross-arms of the steering wheel and the screw-end set in the center of the post. It is only necessary to apply a common wrench to draw the wheel from its place quickly.



The puller and its application on a steering wheel

Milk as a Lubricant for Drilling in Copper

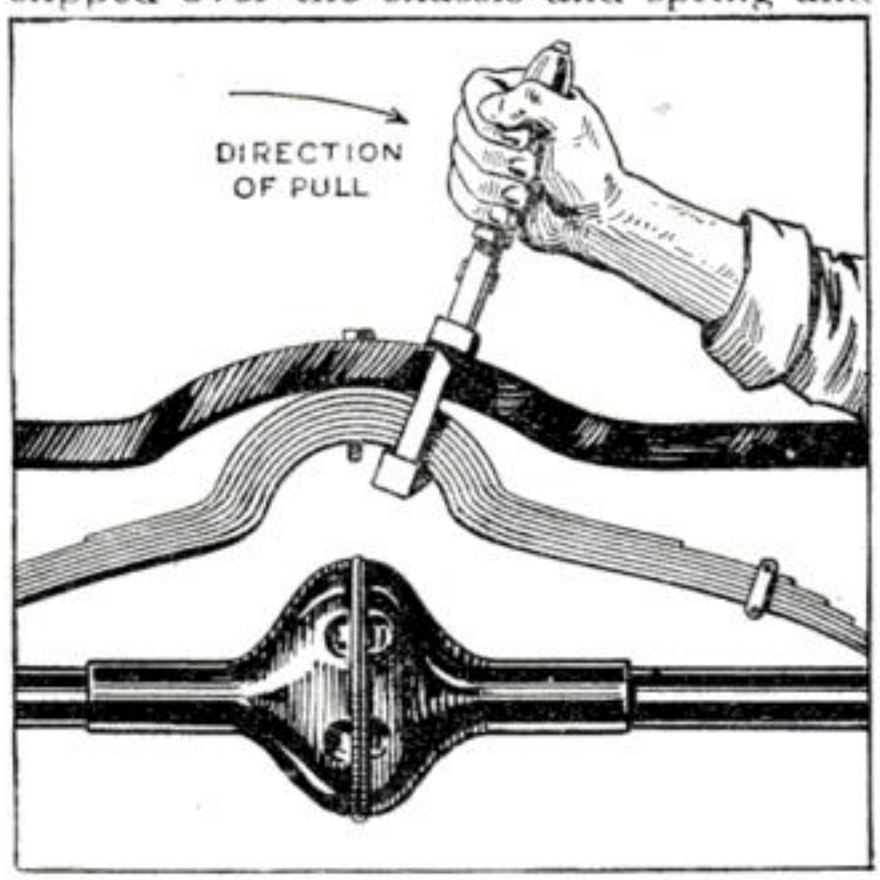
SOME years ago a man came into the writer's shop with a copper tube having a ⅛-in. wall. He wanted fifteen holes drilled into this tube with a No. 80 drill, which is somewhat smaller than a pin. The writer had a dozen drills of this size on hand so one of them was placed in the chuck and the drilling began. That is, it was intended that it should begin. But no sooner did the drill touch the tube than it snapped off like so much glass. Another drill was tried using oil as a lubricant, with the same result. Then soap water, different kinds of oil and every known lubricant were tried but without avail. Finally only one drill was left with not even one hole in the tube to show for the destruction of the other eleven. It seemed a hopeless case. Then as a final resort milk was tried and greatly to our surprise all the holes were drilled with the last drill. This sounds incredible but it is true, nevertheless. The milk contains just enough oil to act as a lubricant and enough water to act as a cooling agent. This combination of oil and water cannot be obtained in any other form. Milk is not only useful in drilling copper, but also in working it in any manner.—LESLIE S. LYONS.

Lubricating the Working Joints of a Pocket Knife

POCKET knives naturally come in close contact with the body and for this reason they become dry and rusty from the heat and perspiration. Necessarily any lubricant must be of some dry material. A very simple and efficient, as well as cleanly method is to use a little powdered graphite on the joints. The graphite may be obtained from the lead of a pencil. After applying it, work the blades a few times to get it into the joints.

Compressing Automobile Leaf Springs to Bolt Them

THE problem of compressing the leaf springs on a Ford was solved in the following manner without the use of the usual clamp. A large wrench was slipped over the chassis and spring and



Drawing spring in close contact with chassis frame for bolting it in position

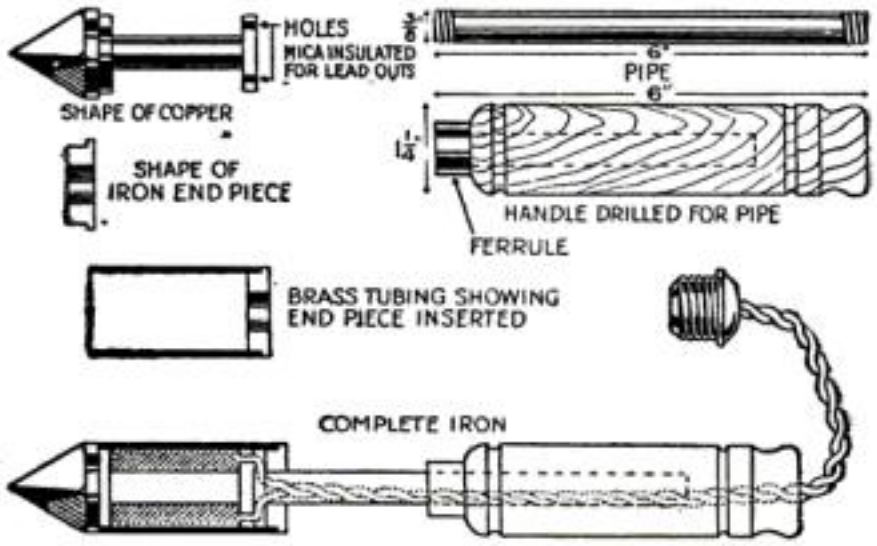
tightened into position, after which the wrench was pulled to the right and the spring was compressed and easily bolted into position. The illustration shows the method of procedure.

The Amateur Electrician

And Wireless Operator

Making an Electrically Heated Soldering Iron

AN electric soldering iron is not a tool for the inexperienced person to build; however, with extreme care and the proper materials, a very good tool can be made. An improperly designed and constructed electric soldering iron may often result in fireworks of a dangerous variety. The home-made kind will be somewhat cheaper than one of a similar size and like heating element and just as good results can be had from its use.



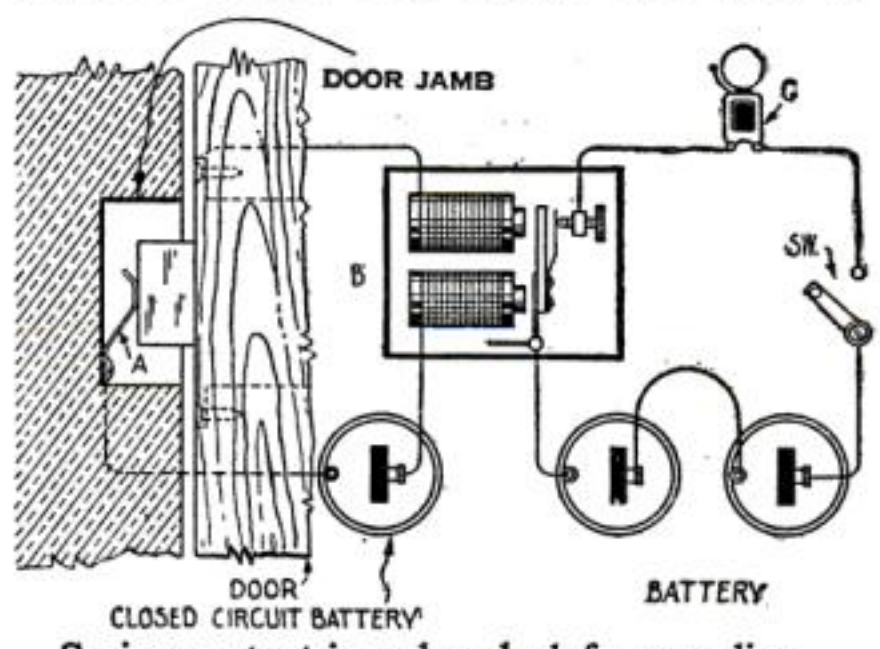
The necessary parts for the construction of an electrically heated soldering iron

The handle is turned in a lathe from maple stock to the dimensions given in the diagram. A hole is bored axially through the handle and a 6-in. length of ⅜-in. gas-pipe forced into it. Two feet of asbestos-covered copper wire should be led through the pipe and handle and to an attachment plug. The other terminals of the wire are attached to the resistance winding. The winding, whose resistance causes the copper head to be heated, consists of 18 ft. of No. 30 nichrome wire, which is wound in six layers on the copper spool. Each layer should be well insulated with leaf mica, and the outer layer well covered. A protective copper tube is pressed over the winding, covering it completely. The dimensions of this tube and of the copper are given in the drawing. Care should be taken that the wire does not come in contact at any place with the metal parts. Without a rheostat the iron will consume about 100 watts.

An Electric Burglar Alarm Attached to a Door-Lock

A BURGLAR alarm which is operated when a door is opened can be constructed by screwing a spring *A* in the back wall of the mortise of the door jamb, bending it so that it makes a contact with the lock-bolt, as indicated in the sketch. The spring forms one contact and the iron covering the door, the other. The two contacts thus formed are connected to bell magnets *B* through a closed circuit battery. The other connections are shown in the diagram.

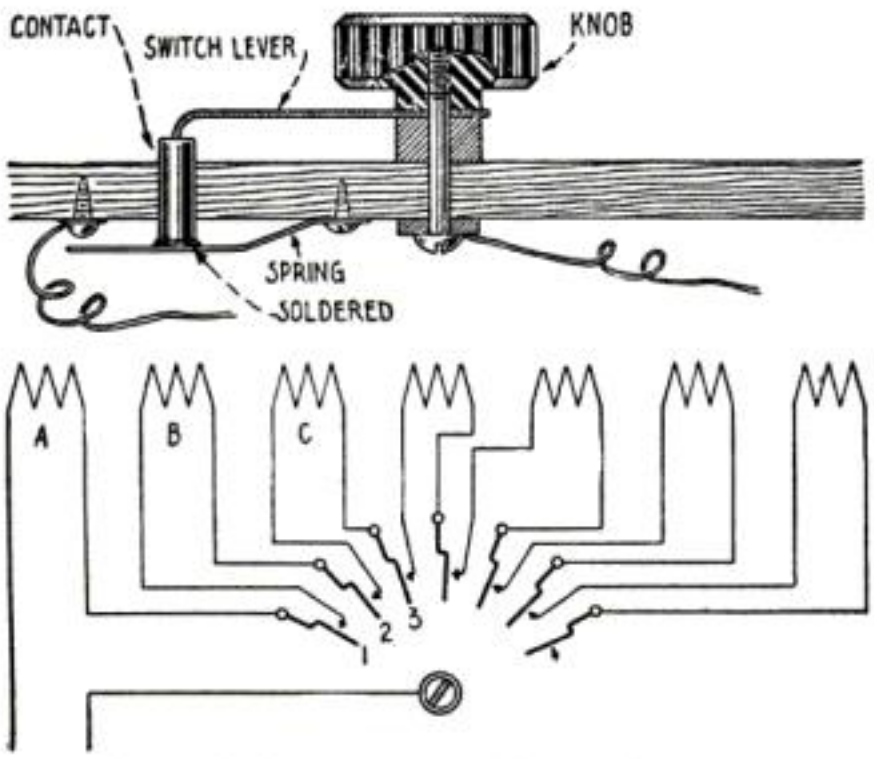
When the door is locked the bell *C* will not ring; but when the bolt is disengaged from the spring the circuit is broken, allowing the armature of the bell magnets to spring back, closing the circuit.—CHARLES W. CHRISTMAN.



Spring contact in a door-lock for sounding a burglar alarm when the door is opened

A Dead End Switch of the Multiple-Point Type

DEAD end switches usually bring to mind the picture of a rotary disk with some sort of puzzling springs and contacts mounted around its edge. The



One of the contacts shown in detail and the wiring diagram for the switch

switch illustrated here is, to all appearances, a regular multiple-point type, yet it is doing all that any dead end switch can possibly do.

As will be seen the contacts fit into a hole cut through the front of the case and extend about ¼ in. to the rear. The rear end is soldered to a short spring-brass strip that normally keeps it pushed outward, the end of the strip making contact with a small screw. The switch-lever should be stiff and its edges curved to glide over the points, moving them inward about ⅛ in.

The parts are attached to a board of insulation, either wood, vulcanite, slate or hard rubber; the wood, however, is easiest covered.

The operation will be apparent if you keep in mind that the switch-lever breaks the circuit beyond each point on which it rests. Thus, considering the hook-up, should the lever be placed on point 1, it will push the spring out of contact with the small screw, leaving coil *A* in the circuit, yet breaking the connection to coil *B*. This operation repeats itself all the way around the contacts, the last one of which requires no extra contact-screw.

Such a switch may be mounted on the secondary of a loose coupler and will greatly increase the sharpness of the tuning. The extra contact-screws are useful in adjusting the distance the contacts extend from the front of the board.

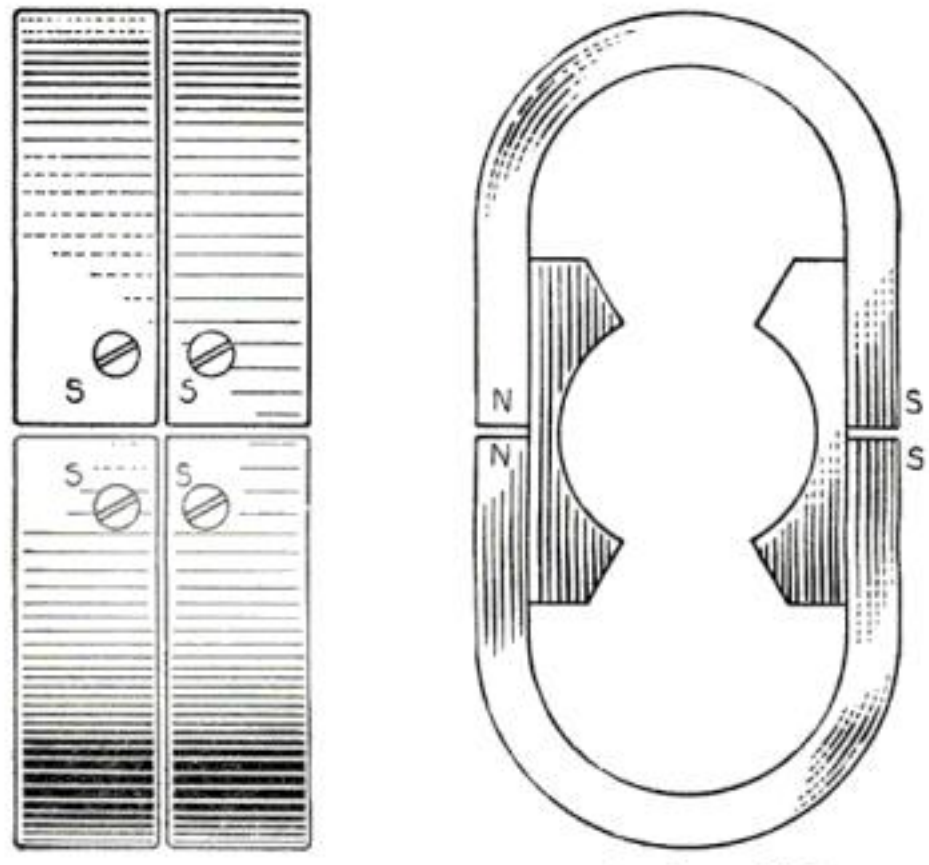
Making an Emergency Aerial for Wireless

IF there is a telephone line running into the house and the aerial is down for repairs, or for some other reason, fasten a piece of tinfoil over the insulated wire of the coiled telephone wires coming into the house, then fasten the "lead-in" wire to the tinfoil and connect the wire in the usual way to the apparatus. This is a practical stunt, and will not hinder the working of the telephone.

Intensifying Magnetic Fields for an Automobile Dynamo

IN the ordinary dynamo, the armature moves between the poles of a number of horseshoe magnets, usually arranged side by side. In the illustration the magnets are shown arranged in the usual manner, namely, on opposite sides of the armature, with their similar poles in juxtaposition. The drawings, for the sake of clearness and simplicity, show only four magnets, although as many as 32 can be used.

The magnets are arranged with the four south poles together on one side of the armature, and the four north poles on the other side. Such a disposal tends to straighten the lines of force, thereby intensifying the magnetic field in which



A method of magneto strengthening which is finding much favor with manufacturers

the armature moves. If the opposing magnets are fixed so that their poles meet on the center line of the armature, the magnetic field will be uniformly distributed around this center line.

How to Become a Wireless Operator

IV.—Simple Adjustments and Connections

By T. M. Lewis

(*Continued from November Issue*)

IN THE article published last month there were given descriptions of a crystal-detector and stopping-condenser to be made and used in connection with the transmitting set of the October article, for sending wireless messages over a distance of a mile or thereabout. Both the detector and the condenser are of types which can later be used in receiving stations which will pick up the messages from large commercial or government plants not only nearby, but hundreds of miles away. With the small sender using a spark-coil, however, the range will be limited to a mile or so, unless the aerials at both stations are large.

The Test-Buzzer

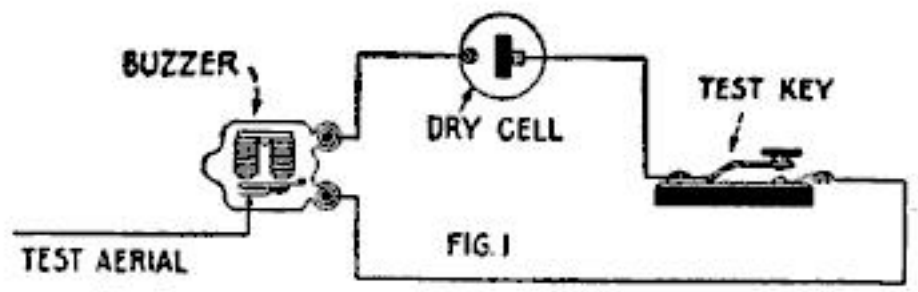
In using a crystal-detector it is necessary to be able to find out instantly whether or not the adjustment is sensitive. When the needle-point bears lightly upon some parts of the crystal, the receiver is sensitive and able to translate messages coming from a distance; with the contact at other points, however, the instruments seem absolutely dead.

Obviously, to be certain that messages can be received effectively, one must be sure that his detector is properly adjusted. The best way to do this, and the way which is used by the professional operators in most large stations, is to take advantage of the feeble signal-waves induced by a buzzer. By setting up a small sending-outfit, such as described in the September issue of the POPULAR SCIENCE MONTHLY in the first article of this series, the sensitiveness of the detector may be tested by listening in the receiving telephones and at the same time pressing the testing-key.

Figure 1 shows how to wire up the buzzer, strap-key and dry cell described in the first article. The only difference from the little sender used to signal from one room to another is that the vibrator-contact post of the buzzer is connected to a miniature aerial wire only a foot or two long, instead of to a genuine, full-sized antenna. The miniature aerial is run along the table about 2 or 3 in. from one of the wires leading to the detector, as indicated in the illustration, Fig. 2.

The Change-Over Switch

In order to shift connections from sending to receiving, there must be provided a good-sized double-pole double-throw knife-switch. The lever-arms of the switch should be at least six inches long, and the



It is necessary to use a test buzzer to find out if the adjustment is sensitive

jaws should be mounted upon a slate, marble, or fiber base a corresponding distance apart. If the switch used is too small it will not have enough insulation to prevent the sparks from the secondary of the induction-coil from jumping to ground by way of the receiving contacts.

A second-hand knife-switch of this size and type can be bought for about one dollar or less; if none can be obtained, it is not difficult to improvise from ⅛ by ½-in. strip copper, an instrument which will work perfectly. It is only necessary to observe closely the construction of the big knife-switches of the double-throw type, in some central station, and to imitate them as accurately as possible. A number of brief articles have been published in the technical magazines, giving details of construction and dimensions for such switches. The connections for the change-over switch are shown in Fig. 2.

The Detector-Protecting Switch

When the wireless station is completely equipped with detector and spark-coil, it is essential to make some provision which will protect the delicately adjusted crystal from the violent impulses set up by the

transmitter. The simplest way to do this is to connect a small single-pole switch (either a knife-switch or a lever-switch of almost any sort will do) directly across the terminals of the detector. In the wiring diagram of the complete station, Fig. 2, the detector-protecting switch is marked *S;* the wires leading from it to the binding posts of the detector should be kept as short as possible; otherwise they may pick up enough current from the sending-spark to "knock out" or destroy the sensitive adjustment of the crystal-detector. When receiving, the protecting-switch *S* must be open, so that the detector can operate to rectify the currents produced in it by the incoming waves. When sending, the switch must be closed. In this position the heavy induced currents are shunted past the detector and the adjustment is not disturbed by them.

Connecting the Complete Set

In addition to the parts of the receiving station fully described in last month's article, the various elements of the transmitter illustrated and discussed in October will be needed for a complete sending and receiving station. In fact, a complete set of parts is necessary for each terminal of the proposed wireless "line." The following must, therefore, be at each plant:

STATION:	
1 Antenna and support	See September and October articles.
1 Loading Coil	" October article.
1 Ground Connection	" September "
1 Change-Over Switch	" above.
Necessary wire for connections.	
SENDER:	
1 Set of dry or storage-cells	See October article.
1 Sending Key	" " "
1 Induction Coil	" " "
1 Spark-Gap	" " "
RECEIVER:	
1 Crystal-Detector	See above.
1 Stopping-Condenser	" "
1 Pair of Telephones	" "
1 Test-Buzzer	" September article.
1 Strap-Key	" " "
1 Dry Cell	" " "
1 Detector-Protecting Switch	" above.

The above-named elements of the complete station must be carefully connected together as shown in Fig. 2. It is a good plan to use No. 16 or No. 18 lamp-cord for the wiring of a set such as this. The twisted pair should be separated and smoothed out, and the single conductors used independently.

It is necessary to keep the transmitting

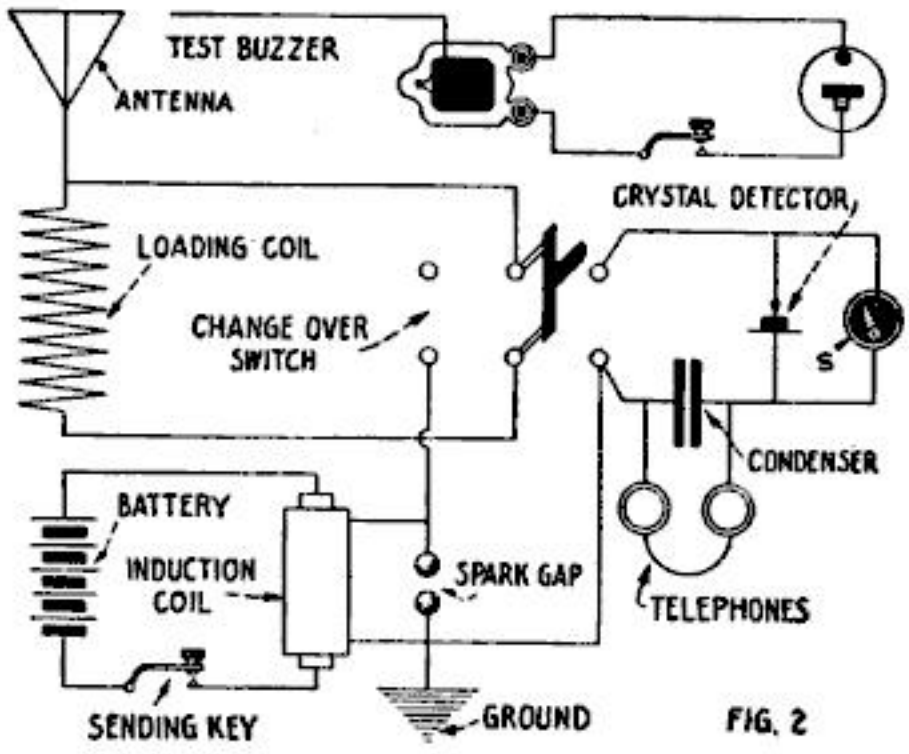


FIG. 2

The wiring diagram of a complete station showing the location of wireless apparatus

apparatus well away from the receiving instruments. The loading coil, for example, should not be nearer than two feet to the detector, telephones and stopping-condenser. As explained in the second article of this series, the lead-wire from the loading coil out to the aerial must be well insulated if good work is to be done. It is very important that the change-over switch be well insulated, also, for three of its contacts are subjected to the full sparking potential of the transmitter (see the diagram of Fig. 2).

The best plan for beginning work is to have the two antennas, one at each station, as nearly alike as possible. If their form and height cannot be made identical, they should at any rate have exactly the same length of circuit. That is to say, there should be the same number of feet measured from the ground connection up through the spark-gap (but not through the loading coil) to the distant insulated end of the antenna, within a few per cent. In this case, i. e., with the lengths practically identical, the loading coils at the two stations can be put entirely in circuit, and the apparatus will be approximately tuned for the interchange of messages.

If one of the aerials is longer than the other, less of the loading coil should be used at that station than at the other. The exact point to clip on to the wire of the loading coil can be determined only by experiment. By trying every turn, it will be found that some one position is

best both for sending and receiving messages. The wire in the loading coil has the effect of lengthening the aerial; it is therefore perfectly clear that, since it is desired to have both antenna systems of the same total length, less of the loading coil must be included in circuit with the longer antenna wire. The coiled wire is more effective in increasing the station's wavelength than the straight wire in the aerial, however; so less of it needs to be added than one would imagine if he merely considered the difference in the lengths of the two aerial wires themselves.

Adjusting and Operating

When the apparatus is set up as shown in Fig. 2, the first thing to do is to put the transmitter into operation. Throw the change-over switch to the left-hand or sending side, and set the spark-gap at about 1/16 in. separation. Making dots and dashes with the key, adjust the induction-coil vibrator to the position which gives a clear, sharp spark between the electrodes of the gap. The spark should be white and snappy, and should sing with the tone of the vibrator. If you cannot get this kind of spark, the set is not working properly and you must go over the antenna insulation to be sure that it is good. If the coil gives a good spark without the aerial connected with it, but won't spark when the antenna and ground are put in the circuit, it is proof that the insulation is not good enough, or that the spark-gap is too wide for the power of the coil. The gap should not be opened more than 1/8 in. at any time.

Having adjusted the transmitter, swing the change-over switch to the right-hand or receiving side. Put on the telephones, see that the detector-protecting switch is open, and hold down the strap-key connected with the test-buzzer. Move the needle-point of the detector around over the surface of the crystal, with light pressure, until the loudest signals are heard in the telephones. The detector is then adjusted and the receiver is ready for use.

The next step is to arrange a sending schedule with your friend who operates the other station. At some fixed time, say four o'clock, let him close his detector-protecting switch, throw his change-over switch to the sending side, and send some predetermined test signal such as "B" in Morse, over and over again, for five minutes. During these same five minutes have your telephones on, your detector-protecting switch open, your detector adjusted to its best sensitiveness, and your change-over switch in the receiving position. If you have built your apparatus correctly and have set it up in accordance with the instructions of these articles, you should have no difficulty in recognizing the "dash-dot-dot-dot" signals being sent from the other station. Promptly at 4:05 your correspondent should stop sending, throw his change-over switch to the receiving side, open his detector-protecting switch, put on his telephones and adjust his detector. At the same time you should go through the opposite change-over, and begin to send him test signals for five minutes. If all is well he will "pick them up" at once, and when you stop at 4:10 he will be ready to reply to you by wireless that he has heard you; you can then give him the corresponding information and proceed to exchange messages.

You must always bear in mind, however, that whatever your station or his sends out will be heard by other stations which happen to be within range and tuned to the same wavelength. Your signals may even cause interference, and prevent the other stations from reading important messages addressed to them. For these reasons, only such transmitting as is necessary should be attempted; and the Government

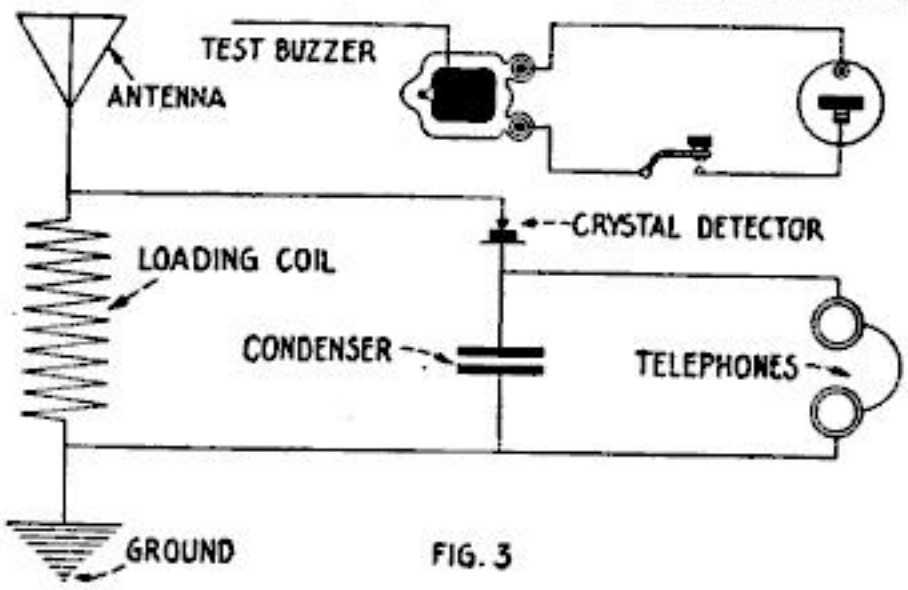


FIG. 3

Wiring diagram for a receiver where it is only desired to transmit messages in one direction

regulations as to the use of a pure wave shorter than 200 meters should be strictly observed. As pointed out in the October article, if over half the loading coil is used at each station and if neither antenna is more than 75 ft. in length, the federal requirements will, as a rule, be met.

Station for Receiving Only

If it is desired to transmit messages in only one direction, the change-over and

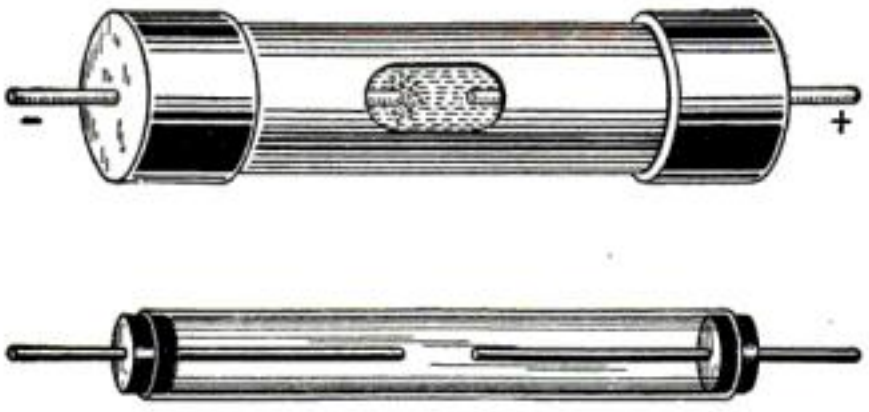
detector-protecting switches may be omitted at the receiver. A loading-coil will be necessary, but since it is to be used for receiving only it may be made as described in the September article instead of highly insulated in accordance with the October description. The transmitter should be connected as shown in October, and the receiver should be wired as in Fig. 3. The comments in this article as to the adjustment will still apply, except that the two switches need not be considered.

The receiving apparatus described here will work one mile easily, and is capable of hearing signals much farther away. In the next article an adjustable receiving set will be discussed, by the use of which signals may be heard from stations located hundreds of miles away.

A Salt Water Polarity Indicator Made from a Burned-Out Fuse

A POLARITY indicator which will determine the positive and negative poles of a direct current line or a battery can be made from a burned-out electric fuse of the cartridge type, a glass tube and two corks. The glass tube, which fits snugly within the fiber cartridge, is cut the same length as the cartridge and a small slot is cut through the fiber as indicated in the drawing.

Short lengths of copper wire should be forced through holes bored in corks which fit tightly into the ends of the glass tube. A diluted solution of salt and water is poured in when one cork is fitted; then the



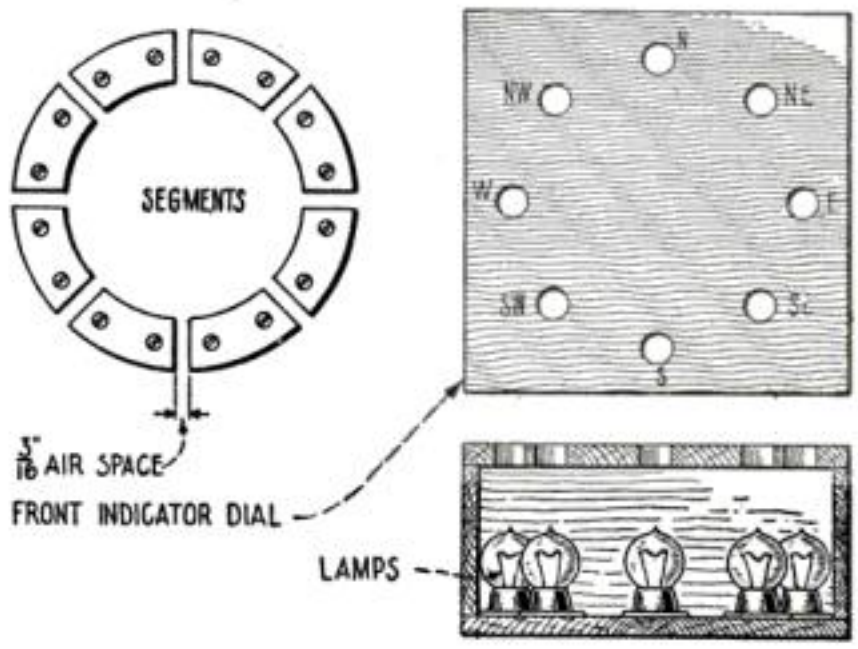
A glass tube with copper wire run through its two corks fits inside the cartridge

other is put in place. The prepared glass-filled tube is then put in place in the cartridge.

When the wire terminals are connected to a direct current, the negative pole will be indicated by bubbles rising from one of the copper plugs. The opening in the fiber permits the bubbles to be plainly seen as they rise.—M. K. GORDON, JR.

An Electrically-Operated Recording Weather Vane

IN YACHT clubs, in laboratories of some sorts, on the farm and other places numerous beyond mention, it is often desirable to know for instant convenience the exact direction of the wind.



Dial and electric segments for showing the wind's direction inside of a house

In the day-time this information is sometimes difficult to secure owing to the fact that the weather vane is perched on the roof of a building out of convenient eye range. Night necessarily increases the difficulty.

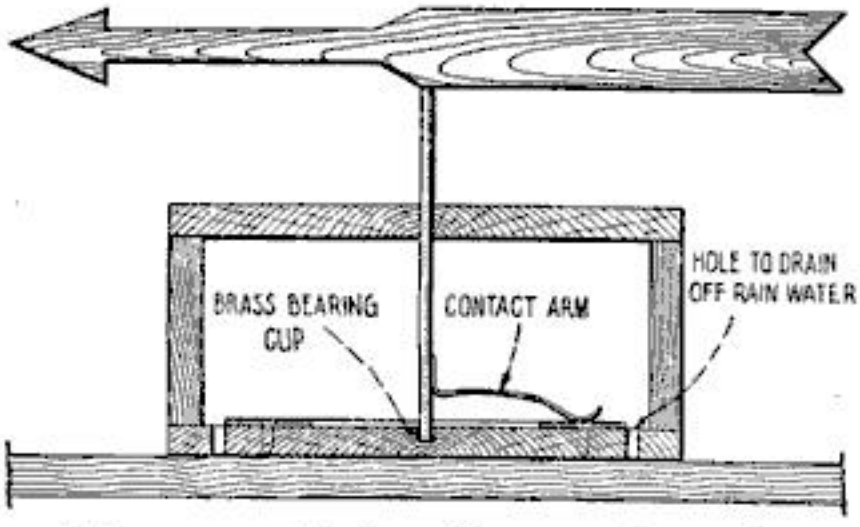
An electric weather vane which will indicate the direction of the wind on a dial conveniently located can be constructed easily. The compass, in the first place, is divided into eight parts, or directions: N, NE, E, SE, S, SW, W, and NW. On the weather-vane dial described, if the wind should be blowing in a direction between two of those indicated—for instance, northeast by north, the two directions, northeast and north will be indicated. Consequently, the vane will register 16 points of the compass instead of only 8 as might be inferred at first thought.

A specially designed weather vane should be erected on a high roof. No vane will register accurately unless it is at a higher altitude than the buildings in the immediate vicinity. This vane consists of the usual light arrow which is pivoted at its center of balance. It can be quickly made from a shingle, sawed or whittled in the shape of an arrow, as indicated in one of the drawings, and then well covered with weatherproof paint or varnish.

The pivot consists of a $\frac{1}{8}$-in. round brass rod which passes through a close fitting hole in the top of a seasoned wood

box to a brass cup in the bottom. It is essential that the arrow swings easily on its pivot. The box should be 3 in. in height and 6 in. square. In the bottom of the box two concentric circles are drawn. The annular ring between the circles should measure 1 in. in width. In this ring, 8 curved metal plates are imposed. They serve as commutators. They should be screwed down perfectly flat and the screw-heads filed flush with the metal surface. An air-space of 3/16 in. should exist between the segments. There will be 8 segments altogether. To the outside rim of each of these a 1-ft. No. 18 annunciator, or bell wire is soldered.

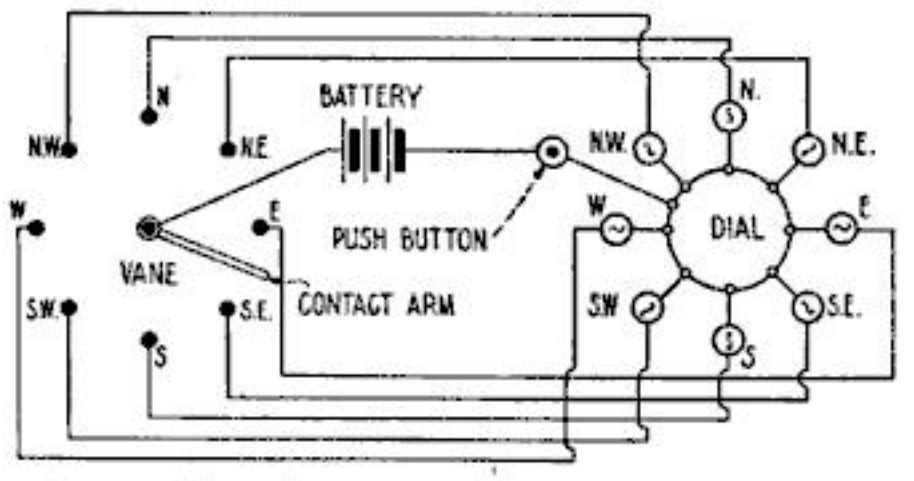
A metal arm, which presses down upon the plates with sufficient force to insure an electrical contact, is soldered on the pivot rod a short distance above its base. It is made from spring-brass ½ in. wide. To counteract its spring-like action, which otherwise would force the rod and the arrow upwards, a ring or flange should be soldered to the rod immediately below the box cover. The tension of the swinging contact should then be adjusted so that, when the cover of the box is on, the arrow will swing freely, but at the same time the arm will make firm contact with the segments. To the metal socket into which the base of the rod fits, another 1-ft. length of No. 18 annunciator wire should be soldered. The directions of the compass towards which each of the segments point should be indicated by tags on the wires which lead from them. This is important.



The vane with its slider-arm for making electric connections with the dial

Otherwise, confusion of an amusing variety will result when the dial is connected and the batteries are in circuit. A westerly wind may be registered as southeast, etc. Holes should be bored in the bottom of the box, to drain off rain water.

A cable of 9 annunciator wires, properly indicated by numbers or letters at the end of each, should be made as follows: Stretch between 2 points, which are as far apart as the distance from the vane to the dial, the



The wiring diagram showing the electrical connections between the vane and the dial

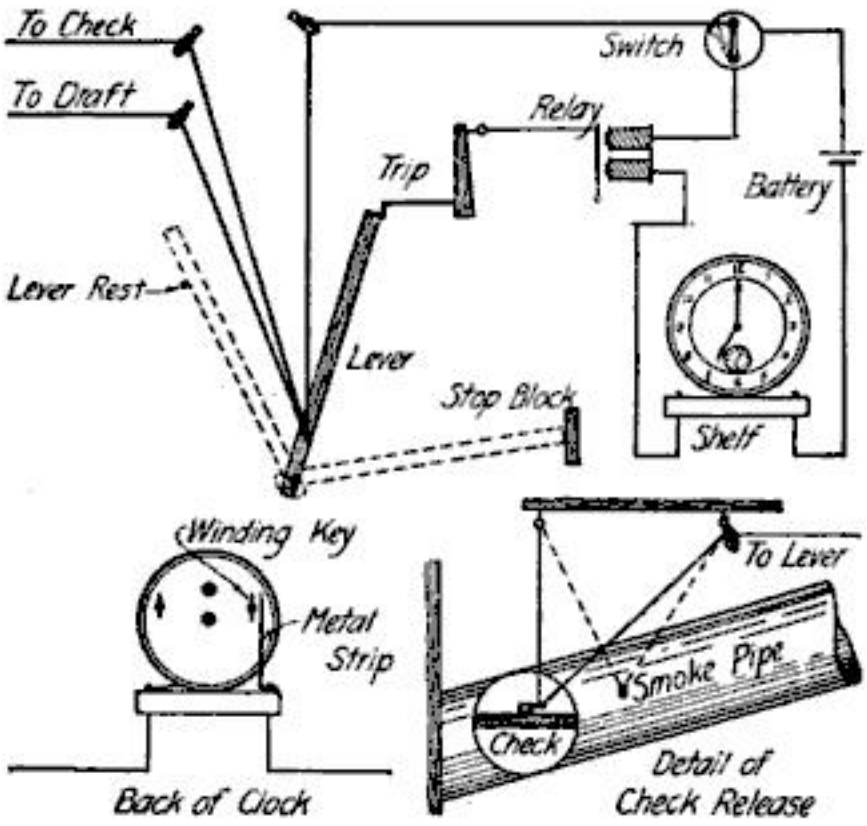
9 annunciator wires. Tar them carefully and while the tar is still soft, wrap the "rope" with insulating tape. The cable should be properly connected to the 9 wires from the vane-segments and contact-arm and led to the room where the registering dial is to be mounted.

This consists of a polished wood box of the same general dimensions as the box on the roof, but with 8 holes each 1 in. in diameter bored in a circle in its front side. A sheet of ground glass is placed against the holes underneath. The 8 directions of the compass are written in black ink on the glass which covers the holes. Under each hole a miniature electric lamp is mounted. The light corresponding to the vane segment which points north is connected to one post of the "north light." The remaining seven segments are connected to their corresponding lights on the dial. The remaining 8 posts of the lamp are connected together and the wire run to one pole of a gravity, or blue vitriol, battery consisting of 3 fresh cells. The 3 cells are sufficient when the cable from dial to vane is no longer than 40 ft. For every additional 10 ft. another cell should be added. If the push button is used, dry cells, not gravity cells, should be employed.

The ninth wire of the cable, the one which leads from the pivot of the vane, is connected with the other side of the battery. If the wind is from a northerly direction, the north light of the dial will be lighted; if in a southerly direction, the south light will show, etc. But if the wind should blow in such a direction that the arm on the pivot rests on two segments simultaneously, two adjacent lamps will light.—G. F. Wörts.

Operating Furnace Checks and Drafts by Electricity

THE device described comprises an actuating lever to operate the draft and check; a relay—a skeleton bell



Electrical connections and wiring for an alarm clock to work the furnace check and draft

or buzzer—to release the lever, and a clock to close the electrical circuit at the proper hour. A thermostat may also be used and connected in the circuit. In addition, there is a trigger intervening between the relay and the lever, and a circuit-breaker which effectively prevents loss of power by short-circuiting the battery after the mechanism has been tripped.

Reference to the sketch will show that the circuit-closer consists simply of an ordinary alarm clock, back of which extends upward a metal strip which makes contact with the winding key in revolution as the alarm goes off and forms a circuit through the clock and a turn or two of bare wire on which the clock rests and which leads to the other terminal. The relay is short-circuited so that the armature does not buzz but is simply drawn sharply up to the magnets, thus pulling the trigger lever forward by the wire connection and releasing the lever by raising the bent wire stop.

As the lever falls it not only opens the draft and closes the check, but pulls a third cord which opens a small battery-switch connected between relay and clock, thus preventing current waste should the winding key chance to remain in contact with the metal strip when the alarm has ceased ringing.

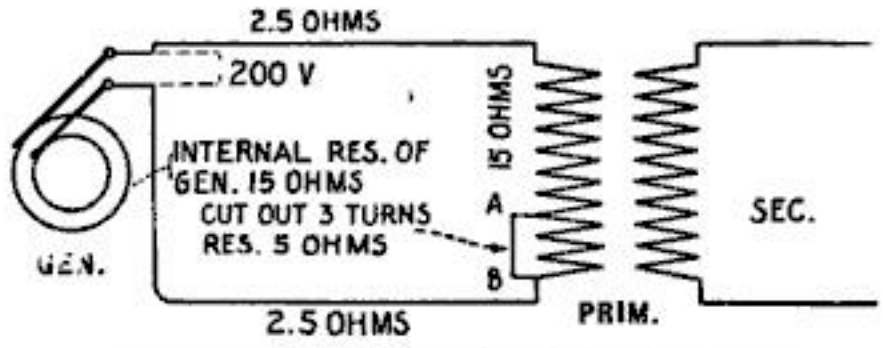
It was found that the check-valve on the furnace in question must be lowered, not raised, to make it draw. The detail sketch shows how this difficulty was overcome by providing a stout wire support for the check-valve which is jerked loose as the lever falls, thus allowing the check to drop to its closed position by its own weight. On a single cell of battery the device will be found to work perfectly.—DEANE S. KINTNER.

Transformer Trouble in Radio Transmitting Apparatus

AMONG the many sources of trouble by which a radio set's efficiency is reduced, a short-circuit of a few turns in the primary of the transformer is to an inexperienced man one of the most difficult to locate, as well as to find a remedy for. With the primary of the transformer short-circuited, two fundamental principles will explain the cause for the lack of efficiency:

1. In order for the greatest efficiency to be obtained, there must be resonance between the primary circuit and the secondary circuit. It is evident that, if some of the turns are cut out of the primary of the transformer, the two will be thrown out of resonance, since the electrical inductance of the primary will be reduced. This, of course, results in poor working.

2. The other fundamental principle is explained by the potential drop in a circuit. Suppose a circuit, as shown, to be partially short-circuited so as to cut out three turns of the nine turns



Locating the short circuit in the turns of a primary of the transformer

which constitute the primary of the transformer, as from *A* to *B*. The total electromotive force and the internal resistance will remain constant, but the external resistance and current are

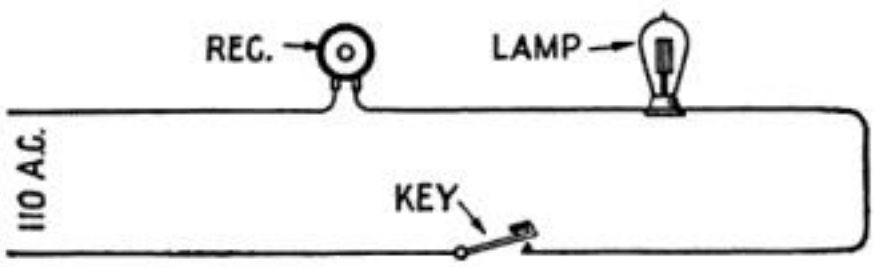
changed by the short-circuit. The current is increased, because of the fact that the primary resistance is lowered by the short-circuit, but the number of turns is decreased. Usually the number of ampere-turns (i. e., the number of effective turns times the number of amperes) is lowered by the defect; and since the energy received by the secondary circuit depends on the number of ampere-turns in the primary of the transformer, it is evident that the efficiency is greatly reduced.

Therefore, an increase in the amperage of the primary circuit with a decrease in the reading of the voltmeter, and a large decrease in the energy of the secondary circuit are good indications of a short-circuit in the primary of the transformer. The amount of the variations mentioned will depend on the number of turns cut out by the short-circuit. Often the shorted section will become very hot.

Trouble of this kind is caused by poor insulation, or excessive voltage being applied. It depends upon the extent of the puncture of the insulation as to what is best to be done for repairs. Occasionally the entire primary must be rewound. If only slightly punctured, it is easily fixed by wrapping the wire in the damaged portion with insulating tape. Much care must be exercised in replacing the wire in its original position.

Practicing the Code Without Using a Buzzer

FOR the amateur who wants to practice the code and has no buzzer, a good substitute can be made from an old 75-ohm telephone receiver. The receiver is hooked up in series with a 16-c.p. light and a Morse key on a 110-volt

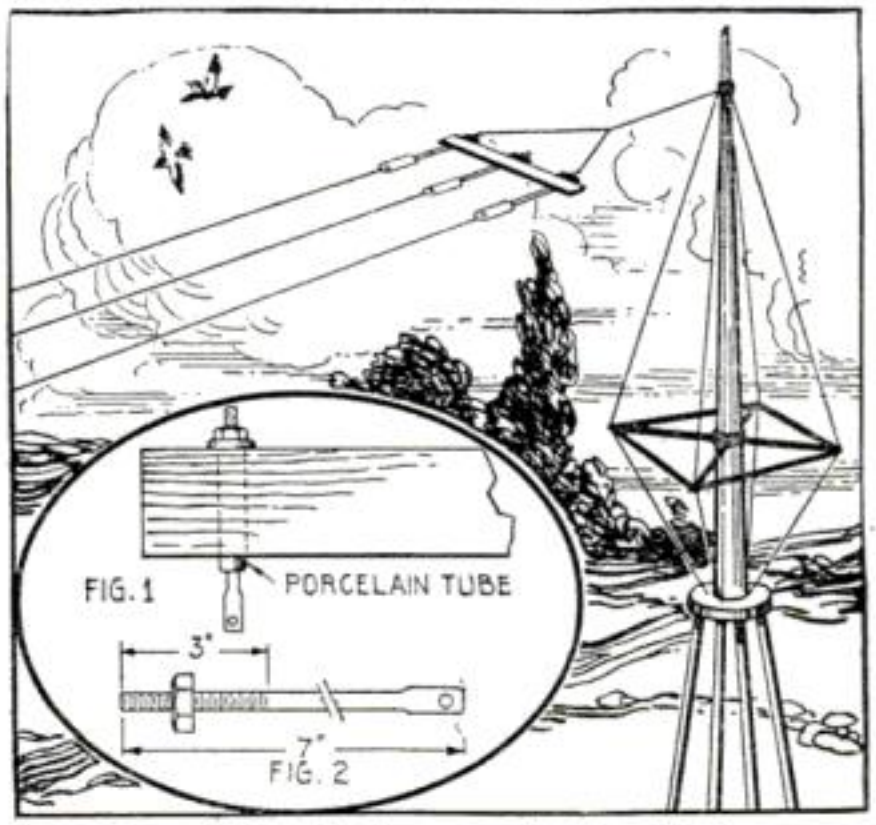


The connections for a key and telephone receiver with an incandescent light

alternating circuit, as shown in the drawing. If the buzz is too loud a smaller c.p. lamp may be used to soften the tone. This method should not be tried on good receivers.—MALCOLM MACURDA.

How To Take Up the Slack in Your Aerial Wires

THE difficult job of getting aerial wires stretched evenly can be easily accomplished by utilizing the arrangement shown in the illustration.



Porcelain tube in cross-bar insulating the bolt for taking up slack in wires

It consists of a porcelain tube—an ordinary unglazed tube about 3 in. long will do—run through a hole in the arm and the holding bolt run through the tube. If bolts having long threads are used, considerable slack can be taken up by merely turning the nut with a wrench. In putting up the wires place the nut in the center of the threaded portion; then it will be easy to shorten or lengthen as desired.—LEE SCHERTZ.

Canada to Protect Her Parks with Radio Service

PHILIP E. EDELMAN of St. Paul, Minn., has been engaged by the Canadian Government as electrical engineer to prepare plans for wireless telephony and telegraphy installations over the 7,000 square miles embraced by the Dominion Parks of Western Canada. The installation will be of a new design specially adapted to the difficult mountain service.

The object of the installation is to prevent game trespassing and to afford a means of instantaneous communication for reporting forest fires and calling for aid in territory where ordinary means of communication are out of the question, as is often the case in Canada.

Preventing Interference of Signals by Amplifying

AN interesting patent on a highly selective arrangement for use at a radio-telegraph receiving station is No. 1,173,079, issued in 1916 to E. F. W. Alexanderson. Realizing that the prin-

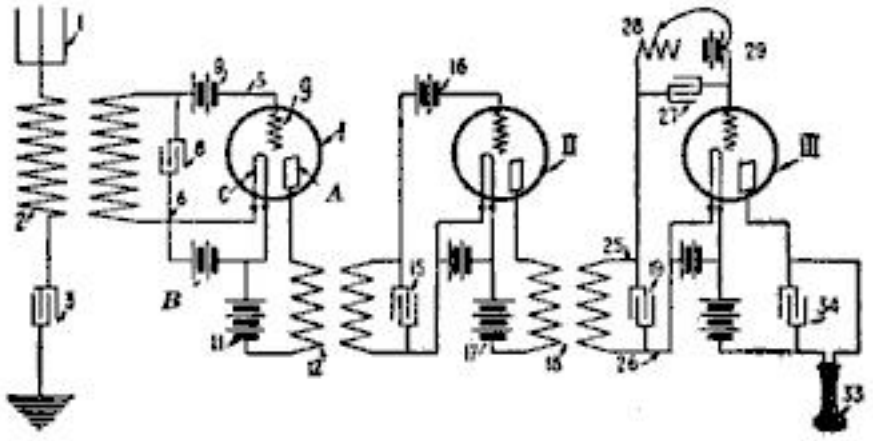


Fig. 1. Inductively coupled circuits in a series of magnifying relays

ciple of selection by tuning to wavelength may be applied several times in the same group of instruments, the inventor has arranged a series of tuned radio-frequency magnifying relays, as shown in the diagrams. The circuits look complicated, but are not very hard to manipulate. Anyone who has two or three audion bulbs, preferably of the double-plate "amplifier" type, will be able to try out a series of experiments along the lines of this invention.

Referring to Fig. 1, it is seen that the antenna 1 passes to earth through the transformer primary 2 and series tuning condenser 3. The secondary circuit is tuned to the desired incoming wavelength by means of condenser 8, and connects via wires 5 and 6 to the grid *G* and filament *C* of the first amplifying tube *I*. Battery 9 is in the grid circuit, so as to adjust the relay to its best magnifying condition, and battery *B* is used to heat the filament (or cathode) *C*. Wing circuit battery 11 has one terminal attached to the filament and the other, through the primary of transformer 12, to the wing or anode *A*. The positive side of 11 is connected to *A;* the proper polarity of the other two batteries of the first tube is to be found by trial.

The second amplifying tube *II* is connected in the same way. Condenser 15 serves to tune the secondary of transformer 12; batteries 16 and 17 take the places of 9 and 11, respectively. The plate circuit from 17 to *A* includes the primary coil of the third transformer 18, whose secondary is tuned sharply to the incoming waves by means of condenser 19. Wires 25 and 26 run to the grid and filament of the third vacuum tube *III*, which is arranged to rectify and "detect" the desired signals instead of merely amplifying them. It will be noted that the grid circuit contains a small series condenser 27, which is shunted by a variable high resistance 28 and a polarizing battery 29; it is through the co-operation of these three elements that the third bulb is adjusted to rectify the signal waves and so to produce pulsating response-currents in the telephone receiver 33 and condenser 34.

It is not necessary to use inductively coupled circuits as shown in Fig. 1. If the tubes are interlinked by suitably designed and tuned auto-transformers, as in Fig. 2, the same results will be obtained. By comparing the two diagrams the similarity of the various parts may be seen; the main difference lies in the substitution of single coils and condensers such as 55 and 60 for the two-coil couplers and capacities typified by 12 and 15. As indicated by the switch in Fig. 2, the telephone condenser 62 (or 34) is not essential.

The high degree of tuning anticipated by the use of this entire arrangement is gained by the successive selectivity of a series of tuned circuits. If each tuned circuit is adjusted to cause a response to the desired signal ten times as loud as to that which is causing interference, and if the desired signal is amplified five times in intensity by each relay

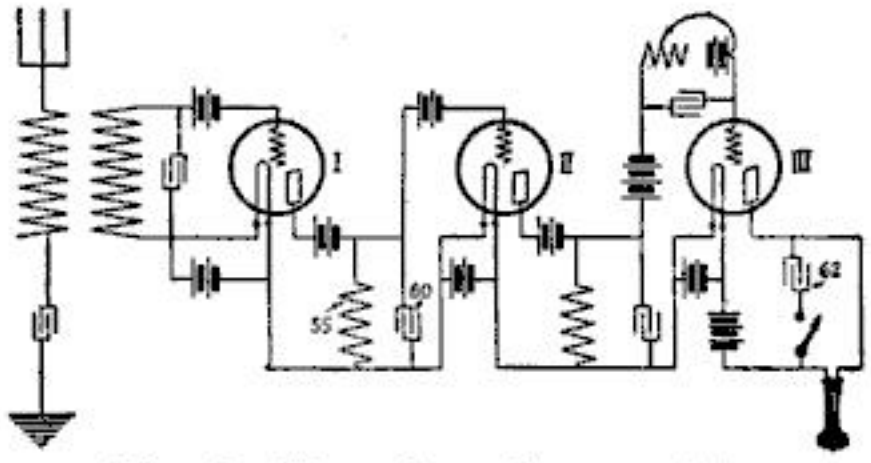


Fig. 2. Here the tubes are interlinked by tuned auto-transformers

tube while the interfering signal is not amplified, it is evident that the final response will contain little of the undesired disturbances. In a normal receiver, having the same selectiveness for individual steps, and not amplifying,

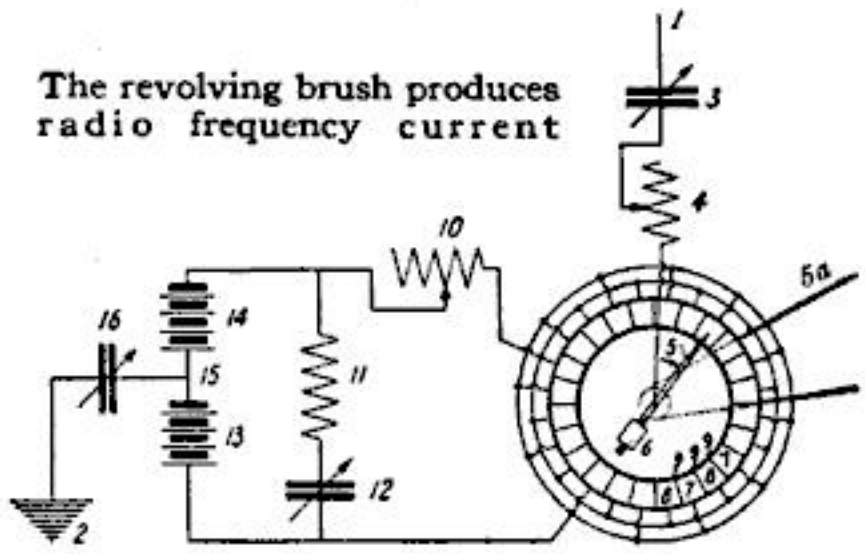
would give a signal ten times as loud as the interference. Under the above assumptions this new receiver would produce a signal thousands of times as loud as the interference. In times of heavy atmospheric disturbance, or when the interference is from powerful nearby transmitters it is probable that favorable adjustment of so delicate an amplifying receiver would be exceedingly difficult to maintain. The device should, however, be useful for many other less trying conditions.

A New Direct-Current Transmitter for Radio Communication

THE use of a commutator for producing radio frequency alternating current from direct current, in a wireless telegraph or telephone sending station, is suggested in U. S. Patent No. 1,172,017, issued to R. A. Fessenden in 1916. The method involves making and breaking a battery circuit, leading to the antenna and ground system, several hundred thousand times per second even for the generation of long waves.

It would be very difficult, if not impossible mechanically, to build a rotating commutator which would operate at such enormous speeds, and the patentee therefore suggests that the commutator itself should remain stationary while the flexible contact brush revolves. If the instrument is built with a diameter of about 8 in. and has segments 1/16 in. wide, there will be room for about 400 contacts around the periphery. If the contact brush is driven at a speed of 30,000 revolutions per minute (which is not higher than the velocities reached by De Laval turbines and certain centrifugal machines) electromagnetic waves of 100,000 alternations per second frequency can be generated. This corresponds to a wavelength of about 6,000 meters.

One set of circuits shown in the patent is given in the accompanying diagram. The generating commutator is formed of segments 8 and 7 placed side by side and insulated by the separating material 9. A brush with flexible tip 5, balanced by the weight 6, is revolved by power transmitted through the belt 5a. The antenna 1 is connected through tuning condenser 3 and inductance 4 to the rotation contact; alternate commutator bars are connected to the opposite terminals of the charging source 13, 14 (which may be either two high voltage generators, or batteries, as shown). The middle point of the power supply is grounded for radio frequency currents, from 15 through the condenser 16 to 2. An additional tuning circuit consisting



of condenser 12 and coil 11 is shunted across the main power leads, and a variable inductive resistance is placed in circuit at 10.

Assuming that the upper terminal of 14 is of positive polarity, and the lower end of 13 negative, the operation of the transmitter may be outlined briefly by pointing out that each time the contact rests upon a bar or the group numbered 8 the antenna system is charged with a positive pulse; when the brush passes to the next contact this charge rushes to earth and the antenna assumes a negative potential. By adjusting the tuning of the antenna circuit as a whole so as to agree with the rate of interruptions of the commutator, strong radio frequency currents can be set up in the aerial and correspondingly intense waves radiated therefrom.

The diagram merely indicates the basis of the method proposed. Difficulties of insulation would suggest the use of two commutators with separate brushes contacting alternately, one for each polarity of charge. Various other modifications of mechanical structure occur in designing a commutator generating machine for regular use. It seems entirely possible that the structural difficulties in the way of building such an alternator would be less than those involved in radio frequency dynamo machines of other types.

What Radio Readers Want to Know

Interesting and Instructive Questions and Answers

Dimensions for a Receiving Tuner; Effect of Variometer on Wavelength

E. C. S., Deer Lodge, Montana, writes:

Q. 1. Please give the dimensions for a 4,000-meter inductively coupled receiving tuner. The secondary winding is to be shunted by a condenser of .0005 microfarads and the primary by one of .001 microfarads. The aerial has a natural wavelength of 450 meters.

A. 1. The fact that the aerial has a natural wavelength of 450 meters does not give us sufficient basis to compute accurately the dimensions of the primary winding. We must know the inductance and capacity of the aerial system to work out the problem. The secondary winding may be wound on a form 4 in. in diameter, 7 in. in length with No. 32 S.S.C. wire. The primary winding should be 4½ in. in diameter, 6 in. in length, wound closely with No. 24 S.S.C. wire.

Q. 2. How many meters will the variometer described on page 539 of the October, 1915, issue of the POPULAR SCIENCE MONTHLY add to the wavelength of a receiving circuit?

A. 2. We would require more details of the particular circuit in which it is to be employed to answer this question definitely; but off-hand we advise that with the No. 20 wire recommended in that issue it will have but a slight effect on the tuning of a circuit. To be effectual it should be wound with No. 30 S.S.C. wire and will then alter the wavelength of a small set about 250 meters.

Making a Transmitter for an Amateur Station

C. F. L., Galveston, Texas, writes:

Q. 1. Please give the data for the construction of a ¾-K.W. open core transformer to be operated on 300 volts alternating current at a frequency of 500 cycles. The secondary winding is to deliver 20,000 volts.

A. 1. Data for an open core transformer is not available at this writing but it may be possible to supply it at a later date. The following, however, is applicable to a closed core transformer. The core is 9 in. in length, 2 1/16 in. in width and 1⅛ in. in thickness. The ends are 5¼ in. in length and of the same thickness. The primary winding has 98 turns of No. 10 D.C.C. wire wound in two layers. The secondary winding is made in sections and has totally 4000 turns of No. 26 D.C.C. wire. The secondary winding should be split into 5 sections wound either in the form of pancakes or multilayered units of 36 layers each. Appropriate insulation between the windings and the core is required.

Q. 2. Give the dimensions for an oil-immersed condenser to be used in connection with the above transformer. I prefer to use photographic plates 8 in. by 10 in. if possible, and should like to have two sections of condensers in series. I propose to use a synchronous rotary spark-gap with this set.

A. 2. We presume that you desire to operate the station at the wavelength of 200 meters and consequently the capacity of this condenser cannot exceed .01 microfarads. If the 8 in. by 10 in. photographic plates are covered with tinfoil 6 in. by 8 in. each plate will have an approximate capacity of .00066 microfarads and therefore 16 plates connected in parallel will give about the required value of capacity. Since you prefer a series parallel connection, you must connect 32 plates in parallel in each bank and then connect the two banks in series.

Q. 3. In view of the fact that my aerial is so small, would not a high voltage set of this character carry further than a ½-K.W. set using a voltage of 7,000 and a quenched spark-gap of poor design?

A. 3. Yes, by all means. The higher potential will enable you to use a greater amount of power with the restricted condenser which the 200-meter wave requires. The fundamental wavelength of your antenna system is about 215 meters and can be reduced to 200 meters by connecting a "short wave condenser" in series with the antenna system, or, preferably, by attaching the lead-in wires to the center of the flat top portion.

A Long-Wave Tuner

J. L., Scranton, Pa.

Q. 1. Where can I obtain the parts and full directions for constructing a 15000-meter inductive coupler of the Navy type, including all the blueprints and necessary diagram of connections?

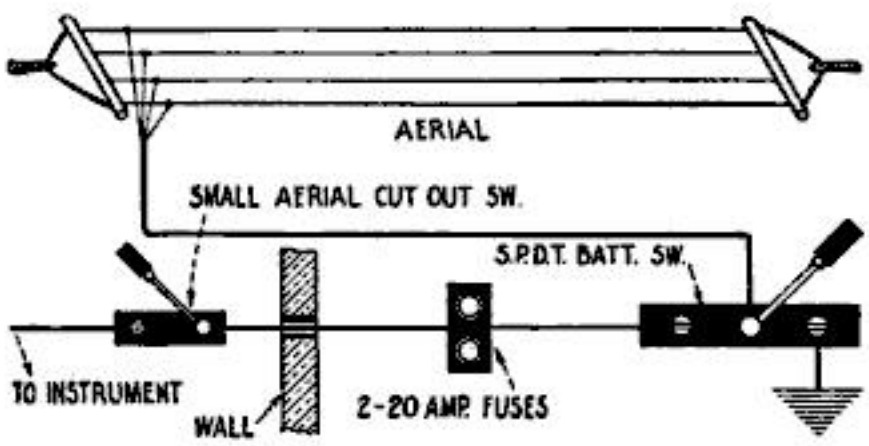
A. 1. We know of no concern which supplies such data and parts. If you have become familiar with the construction and operation of smaller receiving transformers you should have no difficulty in building an apparatus of the sort you wish. The exact dimensions will of course depend upon the size of antenna to be used. For a good-sized aerial, your primary-coil should be of No. 28 wire on a cardboard tube 8 in. in diameter and 18 in. long, taps being taken out at each fifty turns. The secondary may be a 6-in. tube of the same length, wound with No. 36 wire and tapped at each 100 turns. A variable condenser should be placed in shunt to the secondary terminals, for tuning, and a finely-variable loading coil, or variometer, should be placed in series with the primary.

Lightning Protection, Receiving Coil and Condenser

L. P., Miami, Fla., writes:

Q. 1. Referring to the attached diagram, would the apparatus and the connections shown therein be sufficient protection from lightning if located on the outside of a wooden house?

A. 1. The National Inspection Code requires that the antenna be connected to earth through a 100-ampere single-blade double-throw switch, and that the earth connection from this switch be made up of at least No. 4 D.B.R.C. wire. Fuses are of no value for protecting the receiving apparatus because even if they should blow the voltage of the next lightning discharge may be sufficient to jump the gap left by the burned fuse. Mount the 100-ampere switch on the outside of the house in an asbestos-lined box and during severe lightning storms totally disconnect the receiving apparatus from the aerial wires.



Q. 2. In the winding of tuning coils with bare wire, what prevents adjacent turns from actual contact? Is the tube grooved?

A. 2. Yes, it is threaded on a screw-cutting lathe. A fine thread is of course required. Sometimes a cord is wound between the turns of bare wire.

Q. 3. Please give the dimensions for a small receiving condenser?

A. 3. If reference is made to the stopping condenser it may be made up of 20 sheets of tinfoil 2 in. x 3 in. alternated and separated with thin paraffined paper. The entire unit after assembly should be compressed between two strips of wood or hard rubber. See the article by T. M. Lewis in the November, 1916, issue.

Call Book; One Kilowatt Transformer

F. McM., Fairchance, Pa., inquires:

Q. 1. Where may I secure a copy of the new government call book?

A. 1. Send 15 cents to the Government Printing Office, Washington, D. C. A new issue was off the press in July.

Q. 2. Please give the necessary dimensions for a 1 K.W. closed core transformer, using No. 20 wire on the secondary with the understanding that the secondary winding is to be made in two sections.

A. 2. No. 20 wire is too large for the secondary winding of a transformer of this capacity. The complete core for a 1 K.W. transformer when assembled should be 11 in. x 10 in. outside measurements, and the legs 2 in. square. The core is of course made up of a number of pieces of sheet-iron cut to the required length. The primary winding should comprise six layers of No. 12 D.C.C. wire. Approximately seven pounds are required. The secondary winding requires 18 lbs. of No. 32 enameled wire which may be split up into ten sections. It is intended that the primary and secondary windings be mounted on the opposite ends of the core. The primary winding may be insulated from the core by means of eight or ten thicknesses of Empire cloth. The secondary winding may be insulated from the core by means of Empire cloth, enough layers being added to make a separation of at least 3/8 in.

Q. 3. Which of the vacuum-valve bulbs do you consider the most efficient, first as a detector, second as an oscillator; namely, the thermotron tubular audion, oscilaudion, electron relay, and audiotron?

A. 3. All of the bulbs which you mention work on practically the same principle and are more or less identical in operation. We have no preference and know that good results have been obtained with all of them. As an ordinary detector for the reception of signals from damped stations the ordinary audion bulb is preferred, provided it possesses a certain amount of gas, but as an oscillator for the reception of signals by the "beat" method, the highly exhausted bulbs such as those you mention are to be preferred.

Q. 4. What do you consider the best way to use these bulbs, and if possible, give a diagram of connection, first as a detector, second as an amplifier with silicon, third as an amplifier with the Type "A" crystaloid detector.

A. 4. The question is rather comprehensive and would require pages for a complete explanation. Circuits of this type are fully covered in the book "How to Conduct a Radio Club." A copy of this book may be purchased from the Book Department of this magazine at cost of 50 cents. Several types of oscillating audion circuits are described.

Q. 5. Can you give me the wavelength and the hours of operation of high power stations within my range other than Arlington and Sayville?

A. 5. With a long distance receiving set responsive to wavelength up to 8,000 meters, you should be able to hear the Naval Station at Lake Bluff, Ill., and another government station located at Darien, C. Z., Isthmus of Panama. The hours of operation are irregular but they may be heard at intervals throughout the day.

Plans of a Small Modern Dairy Barn

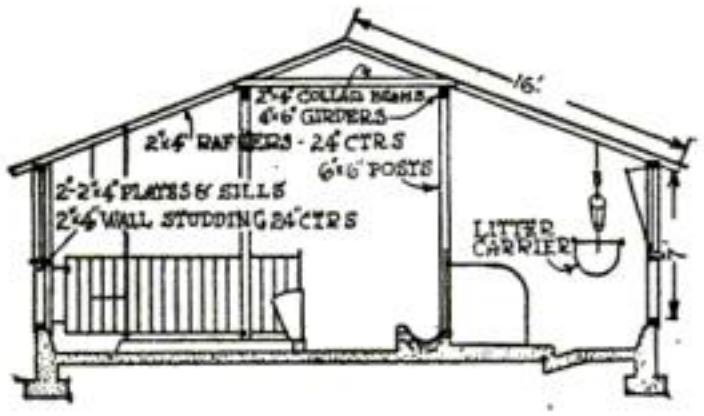
It costs only $500 and it can be enlarged at any time

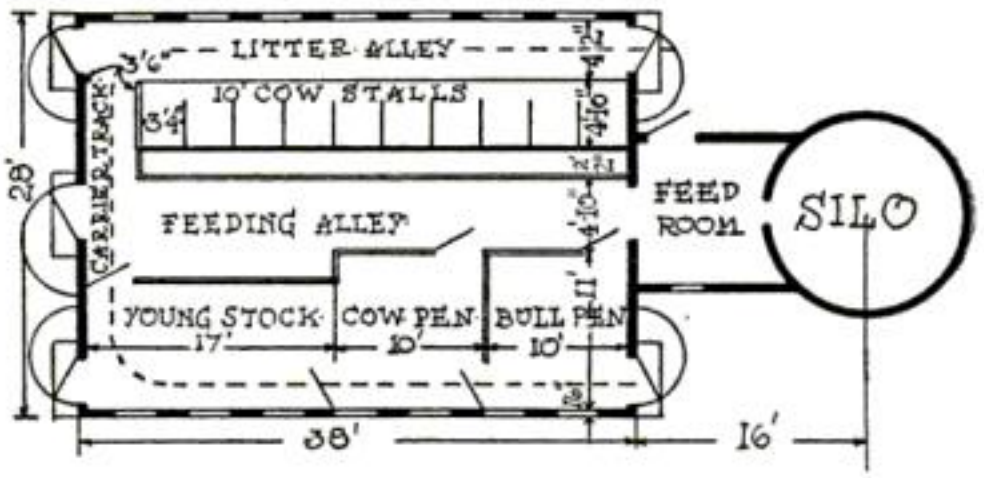
By W. E. Frudden

IF the dairy business is started with only a few cows and it is expected to increase the herd from year to year it will pay to adopt the barn plans shown in the illustration. If desired the barn may be left unfinished on the inside temporarily and when the profits from the herd justify the expense it may be boarded and ceiled or plastered. The capacity of the barn may be increased at any time.

When making additions it must be remembered that there are certain standard material lengths and the structure should be planned in these lengths or their multiples to avoid waste in the cutting of the stock. This applies only to the woodwork. The concrete is laid on a well packed foundation of cinders which will aid in keeping it dry.

The construction is simple, but it is carefully planned to give the proper amount of air space and window surface for each cow and to provide the most convenient arrangements for feeding and barn cleaning. The estimated cost of the structure is about $500 without the silo and the barn and stable equipment. It will cost $1000 to build a two-story barn of this size to accommodate 25 tons of loose hay in addition to the stock; but the hay can be stored very nicely in a shed at the end of the barn at a cost of $125. Where economy is an important factor, the one-story barn meets every requirement without sacrificing any of the features essential to cow comfort.





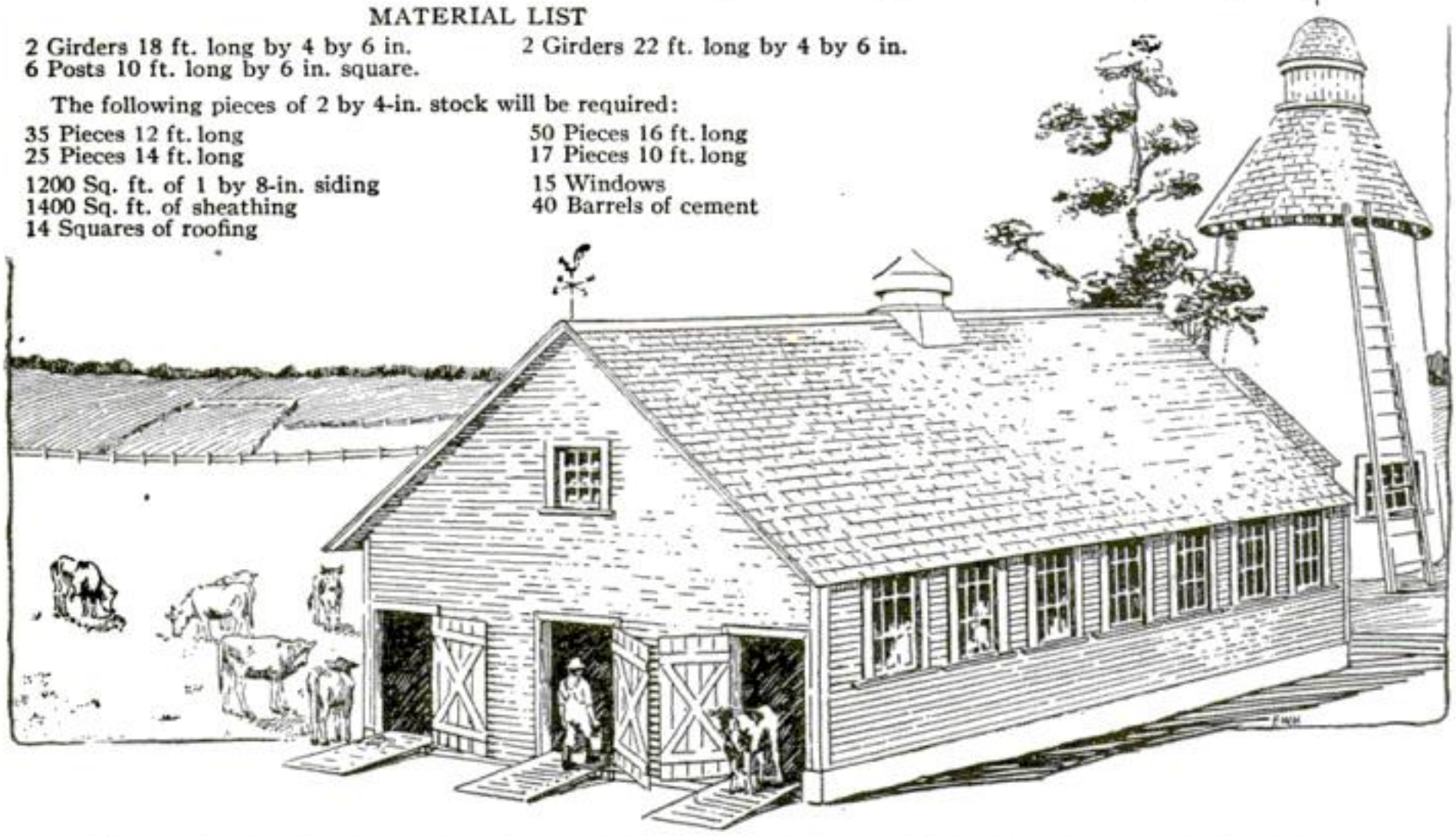
MATERIAL LIST

2 Girders 18 ft. long by 4 by 6 in.
2 Girders 22 ft. long by 4 by 6 in.
6 Posts 10 ft. long by 6 in. square.

The following pieces of 2 by 4-in. stock will be required:

35 Pieces 12 ft. long
25 Pieces 14 ft. long
50 Pieces 16 ft. long
17 Pieces 10 ft. long

1200 Sq. ft. of 1 by 8-in. siding
1400 Sq. ft. of sheathing
14 Squares of roofing
15 Windows
40 Barrels of cement



Plans of a small modern dairy barn that can be enlarged as the herd grows and finished inside whenever convenient. In a one-story structure hay may be stored in an adjoining shed